MACHINERY

Design—Construction—Operation

Volume 41 APRIL, 1935 Number 8

Synthetic Plastic Materials are being more and more used in almost every branch of industry. The manufacture of parts from these materials often requires new types of machinery and new processes that differ materially from those used in cutting and forming metals. Some of these new processes will be described in the leading article in May MACHINERY, *A New Industry Has Created a Demand for Light Machinery.*

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ERIK OBERG .....*Editor*
FRANKLIN D. JONES.....*Associate Editor*
CHARLES O. HERB.....*Associate Editor*
FREEMAN C. DUSTON....*Associate Editor*
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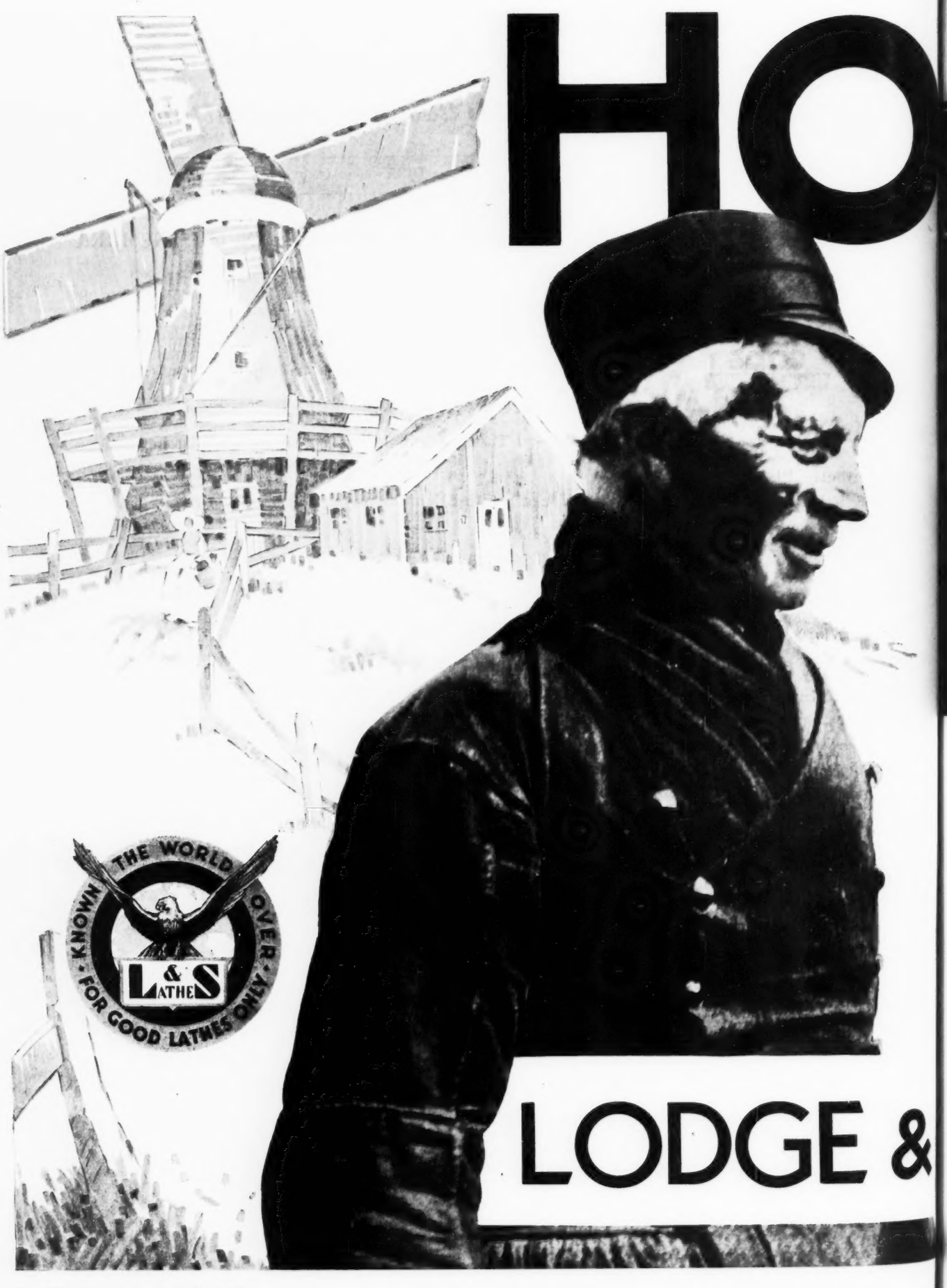
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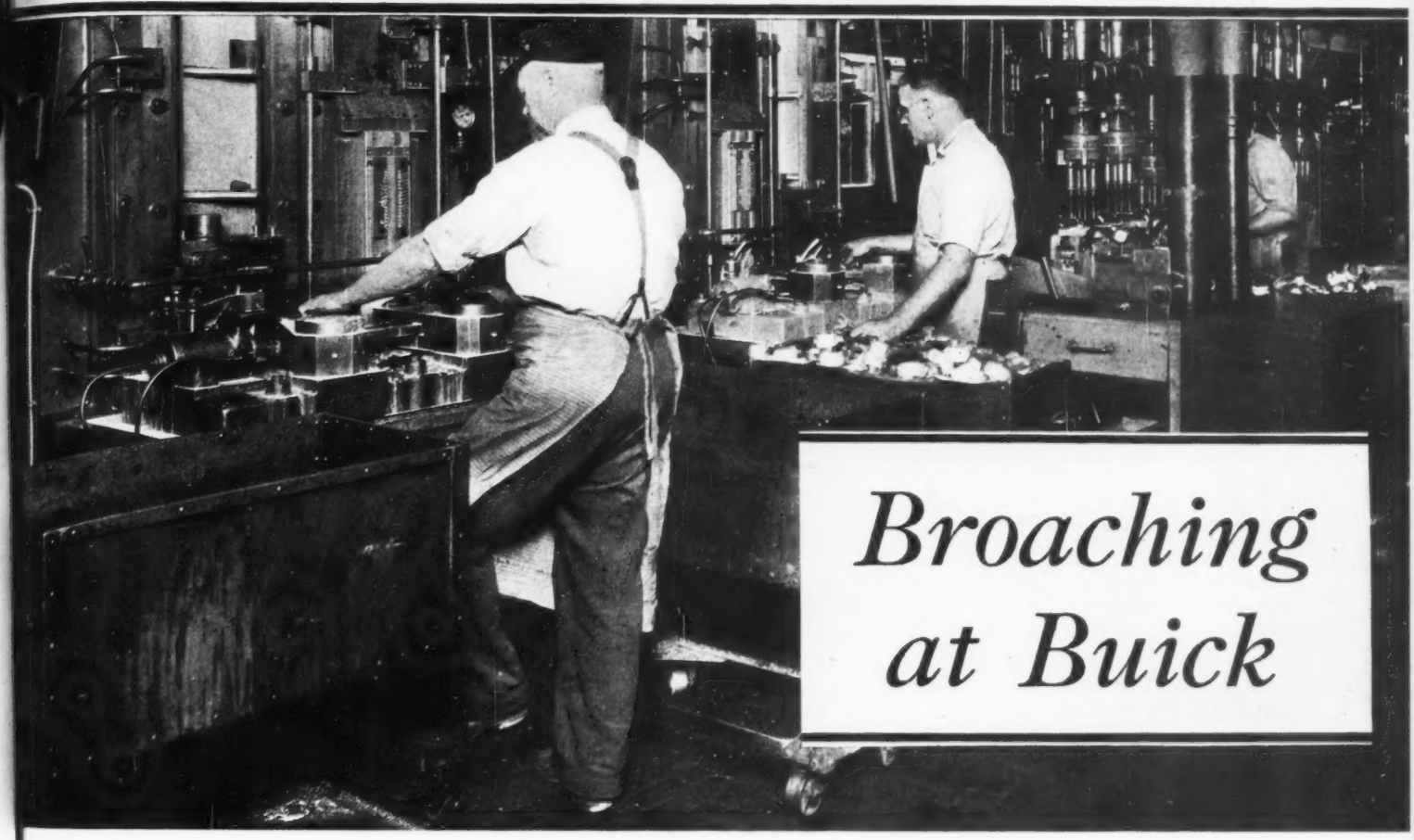


Broaching at Buick

Typical Examples of the Widening Application of the Broaching Process to the Mass Production Problems of the Automotive Industry

By CHARLES O. HERB

EXTERNAL and internal broaching continue to receive increasing recognition by the automotive industry as economical methods of machining parts in large quantities to close limits of accuracy. During the last two years, the use of surface or external broaching in particular has been given considerable impetus by production executives in their search for ways of reducing manufacturing costs without sacrificing quality of the work.

This widening application of broaching has been possible because of parallel advancements in the design of broaching equipment. Hydraulically and mechanically operated machines are available in vertical, horizontal, and rotary types for automatic or semi-automatic operation at speeds suited to the individual piece. Fixtures that automatically index the work into line with the broaches have been designed for use on machines equipped with two alternately reciprocated broaching rams. Broaches built up of a number of sections of different types have been developed for machining a multiple number of surfaces in a single operation.

Broaching operations performed at the plant of the Buick Motor Co., Flint, Mich., will be described in this article. They are characteristic of present-day practice throughout the industry.

Connecting-rods and their caps are broached on the joint faces at the rate of 350 rods and caps an hour by the two Lapointe hydraulic machines seen

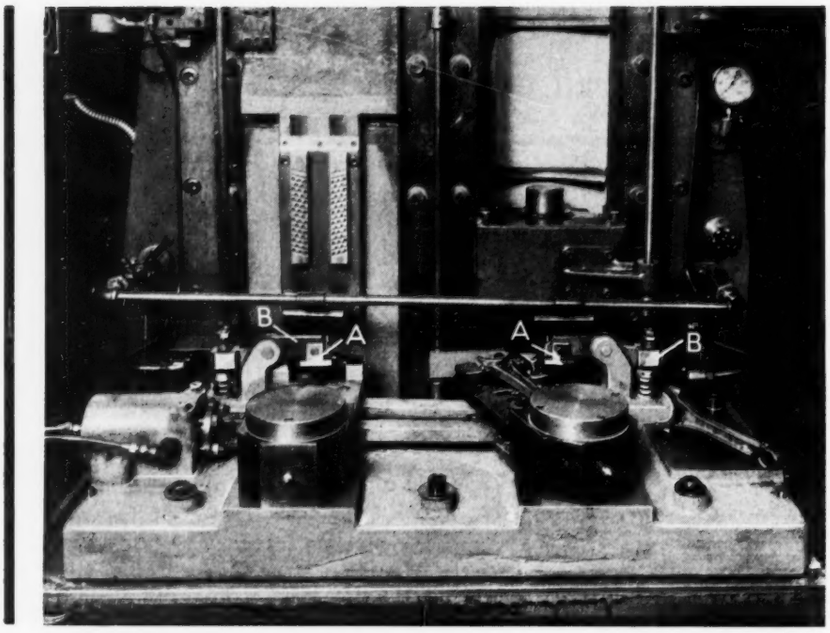


Fig. 1. Hydraulically Indexed Fixtures Speed up Broaching of Connecting-rods and Caps on Vertical Machines

in the heading illustration. These parts are for the Model 40 moderate-priced automobile. The specified distance from the center of the piston-pin hole in the connecting-rods to the joint faces is 7.250 inches, and this dimension must be maintained within plus or minus 0.002 inch.

Fig. 1 shows a close-up view of the machine tooled up for the connecting-rods. The fixture at the left is seen in the broaching position, and the fixture at the right in the loading position. When the left-hand ram descends, the right-hand ram rises, and as it reaches its top position, the right-hand fixture swings into place for broaching the newly loaded connecting-rod with the next downward movement of the ram. In the meantime, as the left-hand ram reaches the end of its downward stroke, the left-hand fixture swings approximately 15 degrees to the right to facilitate reloading and to permit the left-hand ram to ascend without interference during the next cycle of the machine. Each cycle consists of a downward movement of one ram and an upward movement of the other. A foot-pedal must be depressed to effect each cycle.

The broach rams are hydraulically operated, and this is also true of the two fixtures. The cylinder at the left-hand end of the fixture base is connected to the right-hand fixture by means of a long link, while a short link connects the left-hand fixture to the right-hand one. Both fixtures are moved in the same direction as the piston when oil pressure is intermittently delivered to the cylinder through its front and rear ports.

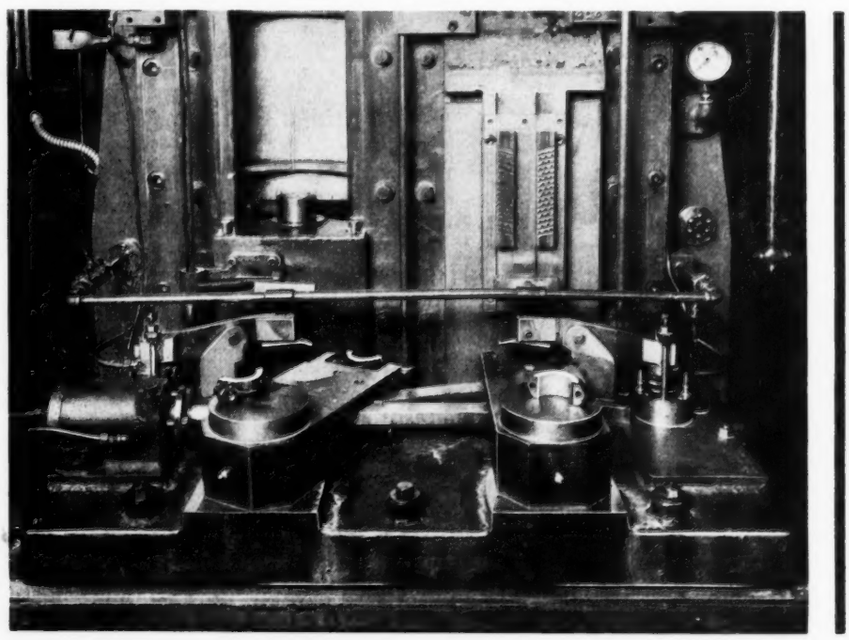


Fig. 2. Spring-operated Levers Automatically Clamp Connecting-rods and Caps for the Operation

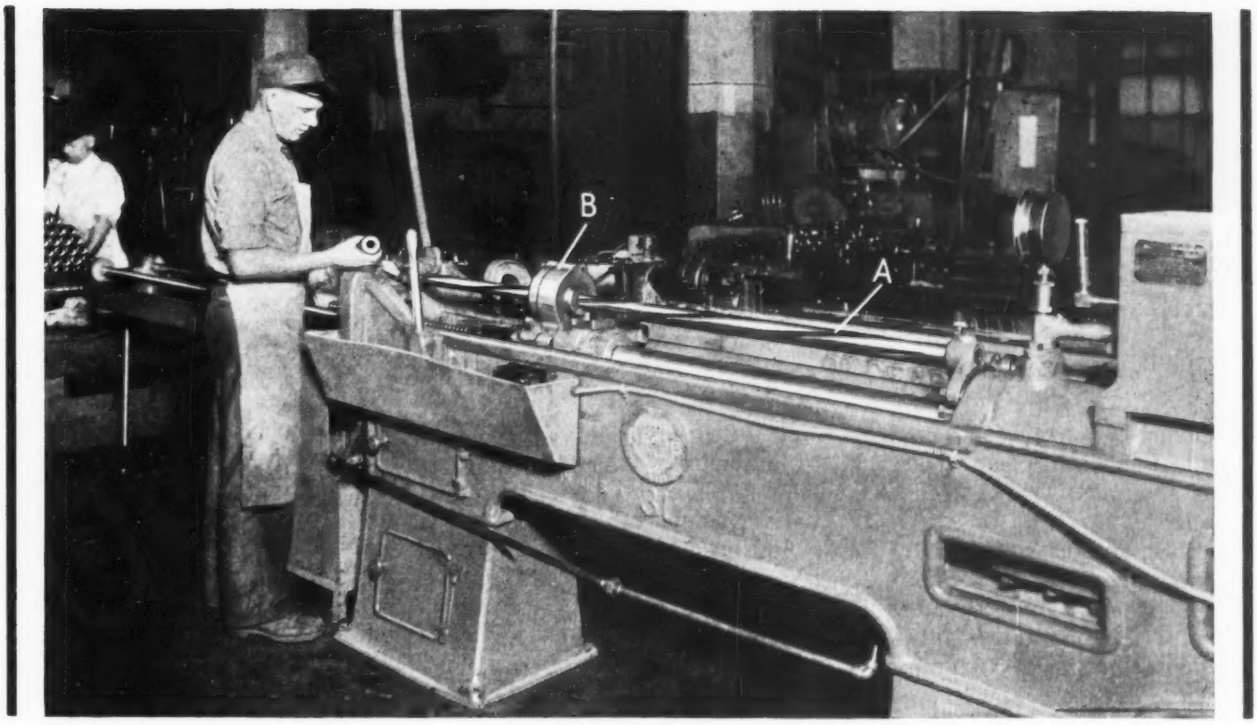


Fig. 3. Helical Splines are Accurately Broached in Sliding Clutch Sleeves by Horizontal Machines Equipped with a Long Helically Splined Shaft that Imparts a Rotary Movement to the Broach

Accurate locating means have been provided to insure that the surfaces broached will be closely parallel with both the vertical and horizontal center lines passing through the piston-pin hole. The previously bored piston-pin hole is seated over a pilot pin, and the previously milled bolt-hole bosses on the sides of the crankpin end of the connecting-rod are seated between two buttons. The bottom boss at the crankpin end of the connecting-rod rests on two pins and the piston-pin boss is also adequately supported. Both of these bosses are coined to size within 0.005 inch before the connecting-rods are delivered to the broaching machine. A small projection on one side of the connecting-rods identifies the side that is to be placed uppermost in the fixtures.

Each connecting-rod is automatically clamped by block *A* as it is indexed into the broaching position. This block is tapered, so as to enable the rod to slide beneath it, and it swivels to permit a firm seat on the I-beam section of the rod. Sufficient pressure is exerted by the spring-actuated lever *B* to hold the connecting-rod for the operation.

The equipment used in broaching the connecting-rod caps is identical to that employed for the rods, except that different locating means had to be provided. Also, the clamping arrangement is slightly different, as will be seen from Fig. 2, although the principle is the same. When the caps reach this operation, they have been spot-faced around the bolt holes on the side opposite the bearing surface. These spot-faced surfaces are seated against two buttons in the fixture, a locating method which insures that the broached joint faces will be a definite distance from the top of the bearing surface when the babbitted bearing has been precision-bored. Two other buttons register against the milled sides of the boss-hole bosses. The coined bottom side of the cap seats firmly on other stops. In this operation, the distance from the joint faces to the spot-faced surface of the bosses is held to size within plus or minus 0.002 inch.

About 0.010 inch of stock is removed from both the connecting-rods and the caps in these operations, and approximately 5000 pieces are finished per grind of the broaches. The cutting section of the broaches is 8 inches long, and the broaching speed is at the rate of 20 feet a minute. The connecting-rods and caps are drop-forged from S A E No. 1045 steel.

Helical Splines Require a Rotary Movement of the Broach

Three hydraulically operated horizontal machines produce helical splines in a sliding clutch sleeve employed in shifting from the second to third "speeds" and vice versa in Buick automobiles. Fig. 4 shows at *A* the rough drop-forging from which these sliding sleeves are made. It is S A E No. 3150-A steel.

The rough drop-forging is first countersunk in

Fig. 4. Helical Splines in Sliding Clutch Sleeves are Broached from the Forged Hole in Three Operations

one end and then passed to the first of the three broaching machines seen in Fig. 3. This machine finishes the hole to the desired size, removing about 1/32 inch of stock on the diameter, and then cuts six splines, as illustrated at *B*, Fig. 4. The second machine removes every other spline, as indicated at *C*, and takes off approximately 1/32 inch of stock all around the remaining splines, as well as a similar amount of stock off the maximum diameter of the hole. The third machine takes 1/32 inch of stock off each side of the three splines, leaving the part as shown at *D*. The splines have a pitch diameter of 1.2558 inches. The minimum diameter across the splines is 1.124 to 1.125 inches, and the maximum diameter is 1.341 to 1.342 inches.

The helical angle of these sliding clutch sleeves is 5 degrees 30 minutes 9 seconds, which gives a lead of 40.9537 inches. The lead must be true within plus or minus 0.0003 inch for the entire length of the part, which is 4 inches. To obtain the desired accuracy, each broaching machine is fitted with a shaft *A*, Fig. 3, that is splined helically to correspond with the lead required in the sliding sleeves. A gear contained in head *B* at the end of the broach ram slides on shaft *A* and the rotary movement imparted to this gear as it moves along the shaft is conveyed, in turn, to a second gear on the broach ram. Consequently, the broach is rotated an amount corresponding to the desired lead as it performs its cutting stroke.

The sleeves are held in each machine in a simple fixture of a floating design that permits the part to position itself to suit the broach movement. This construction relieves the broach of sidewise strains. Broaches 59 inches long are used in the machines. The production per machine averages 93 pieces an hour. The broaching cuts are taken at the rate of about 23 feet a minute.

Thirteen Surfaces Broached on Harmonic Balancer Parts

The crankshaft of Buick automobiles is fitted with a harmonic balancer that is made of two drop-forgings such as shown in the rough in Fig. 5. Three different sizes of these harmonic balancers

Fig. 5. (Right) Rough Drop-forging that is Machined into Half of a Harmonic Balancer for the Crankshaft of Buick Automobiles

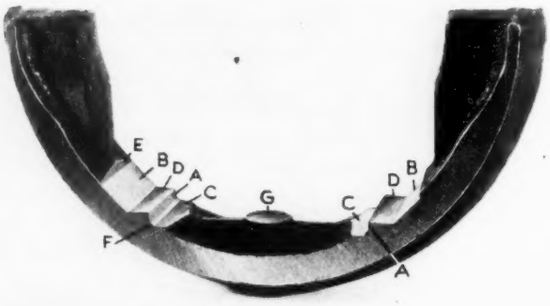


Fig. 6. (Left) Thirteen Surfaces are Finished in One Operation on Harmonic Balancer Halves by Employing a Composite Broach

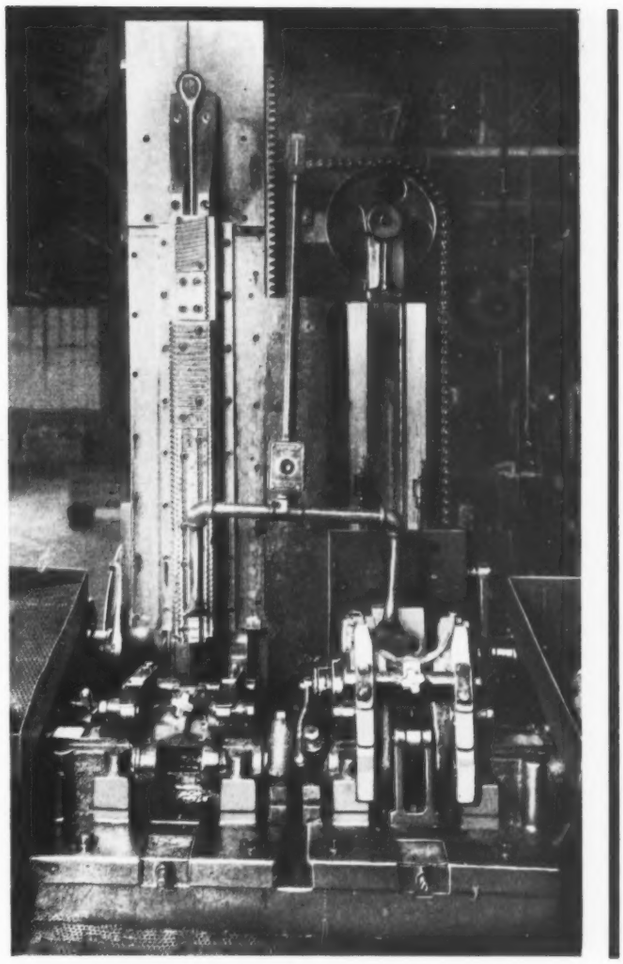


Fig. 7. A Vertical Machine Equipped with Two Rams and Automatic Indexing Fixtures Broaches Harmonic Balancer Parts

are made to suit the different automobile models. This article will describe an operation performed on the balancer for the largest car.

When these harmonic balancer drop-forgings reach the machining department, they are first straightened and flattened under a 1000-ton press equipped with coining dies. Then one side of the part is surface-ground to provide an accurate seat for locating purposes in broaching thirteen surfaces, as indicated by the reference letters in Fig. 6. The broaching operation is performed in a Foote-Burt mechanically operated machine (Fig. 7), which is equipped with two broaching rams that perform cutting strokes alternately. The work fixtures are automatically swung into and out of the broaching position. This machine makes a complete cycle in 22 seconds, during which time two pieces are completely broached.

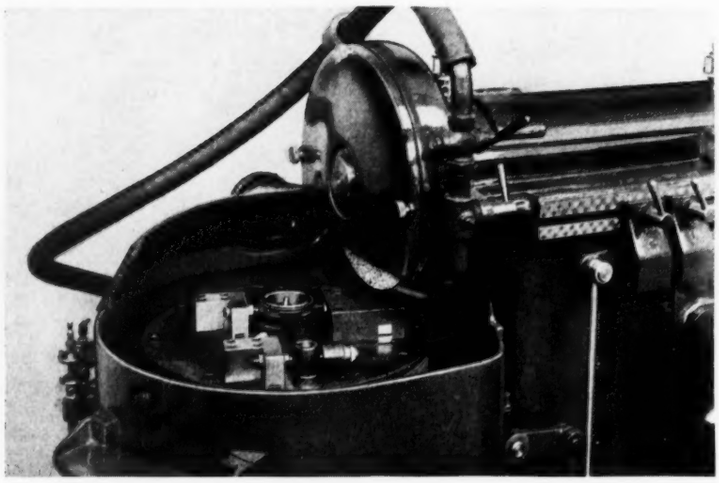
An important requirement in this operation is that the horizontal distance between shoulders *A*, Fig. 6, be maintained between 3.499 and 3.500 inches. Also, the angular surfaces *B* must be held within close limits relative to shoulders *A* and surfaces *C*. A profile gage is employed for checking all of the surfaces broached. The tolerance for surfaces *C*, *D*, and *B* is 0.005 inch.

The broach for machining this multiple number of surfaces in one operation is of a composite design, being constructed of twelve sections. Each of these sections can be removed independently, if required, or the entire broach-holder can be dismantled. Beginning at the bottom end of the broach, teeth are provided for approximately three-fourths of its length for machining the various surfaces, and the remaining one-fourth of the broach consists of teeth for sizing the distance between shoulders *A* and for sizing surfaces *C* and *G*. The greatest depth of cut is taken by the broach edges that produce corners *F* to angles of 45 degrees. The maximum depth of cut is 1/4 inch.

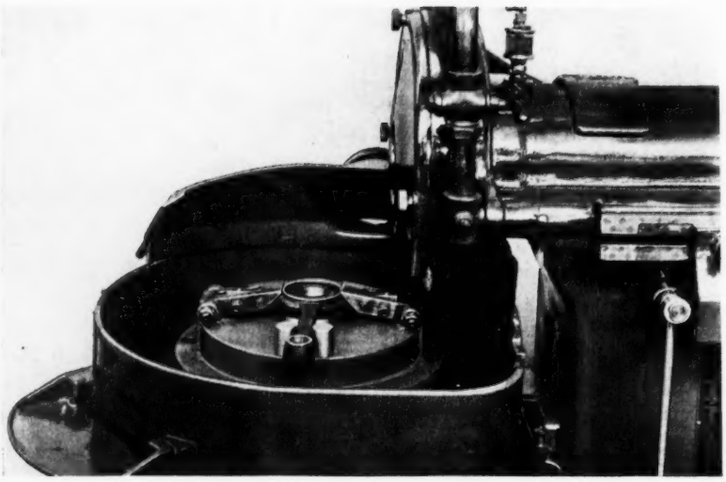
In Fig. 7, the left-hand fixture is shown in the broaching position, while the right hand fixture is shown tilted forward into the loading position. Indexing of each fixture into the loading position occurs as the respective ram reaches the bottom of its stroke. The fixture is swung back into the cutting position when the ram has returned to the upper end of its stroke.

For the broaching operation, the harmonic balancer part is placed in the fixture with the ground side seated firmly against supporting blocks. The outer round contour of the part rests against two angular blocks that form a vee. Fingers are tightened on the ends of the part to locate it centrally by turning a hand-crank. This crank is of a self-locking design. A clamp that is tightened by means of a small starter wheel also supports the work at the bottom point of its contour. The clamping of the part firmly on its ground seat during the operation is accomplished automatically by means of two flat springs which are forced down on top of the work as the fixture swings into the broaching position. The back ends of these springs ride over cam-shaped rollers.

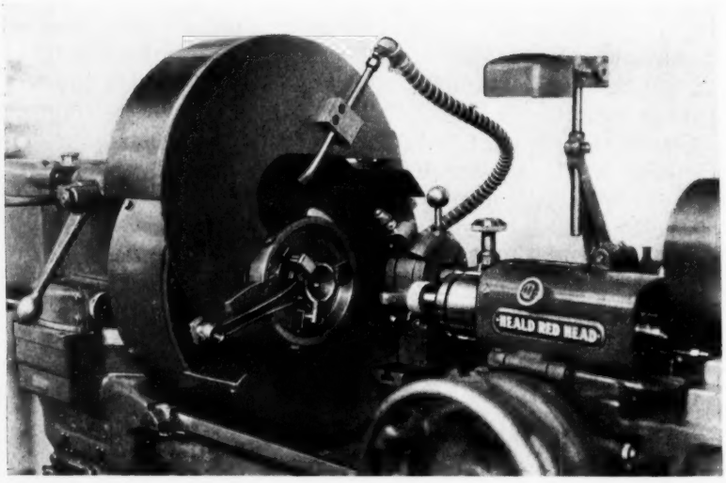
Typical Grinding Operations



The Use of Bronze Bearing Liners in the Crankpin End of Automobile Connecting-rods Requires Bores that are Round and Straight within Close Limits. The First Step Taken by Some Shops to Attain this Accuracy is to Surface-grind One Face of the Connecting-rods on a Rotary Type of Machine as Here Shown.



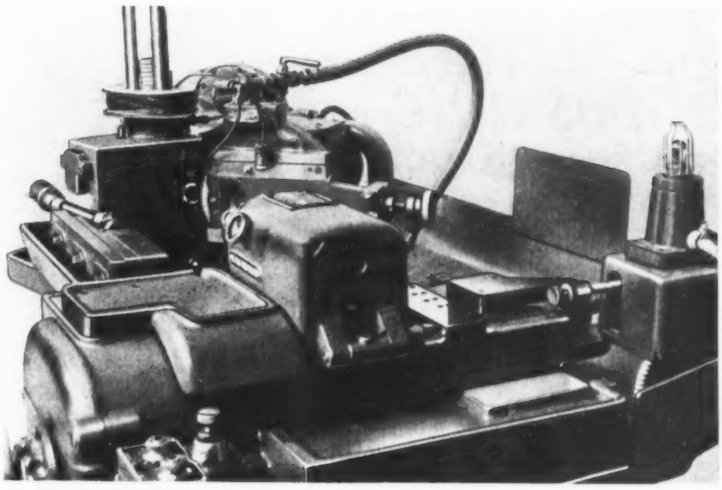
The Next Step in Preparing Connecting-rods to Receive the Bearing Liner in the Crankpin End is to Grind the Opposite Face of the Bearing Boss. Two Machines and One Operator Perform Both Face Grinding Operations on from 100 to 120 Connecting-rods an Hour.



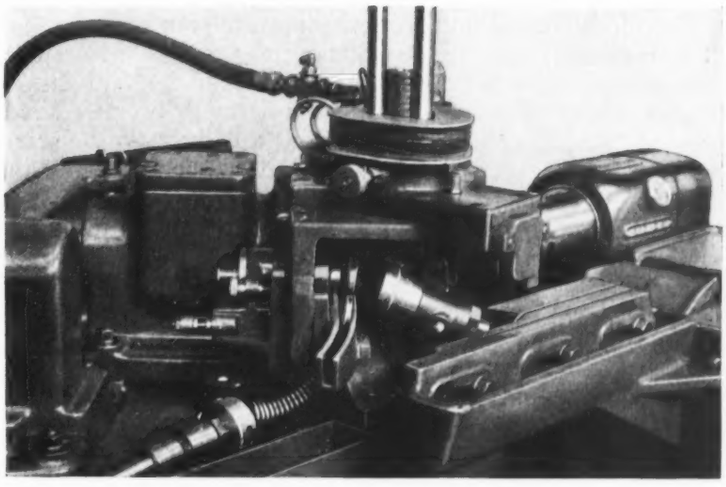
The Final Operation Performed on the Crankpin End of Automobile Connecting-rods to Receive the Bronze Bearing Liner Consists of Grinding the Bore. On Gage-Matic Grinding Machines Set Up as Illustrated, the Production in this Operation Varies from 70 to 85 Pieces an Hour.

in Automobile Plants

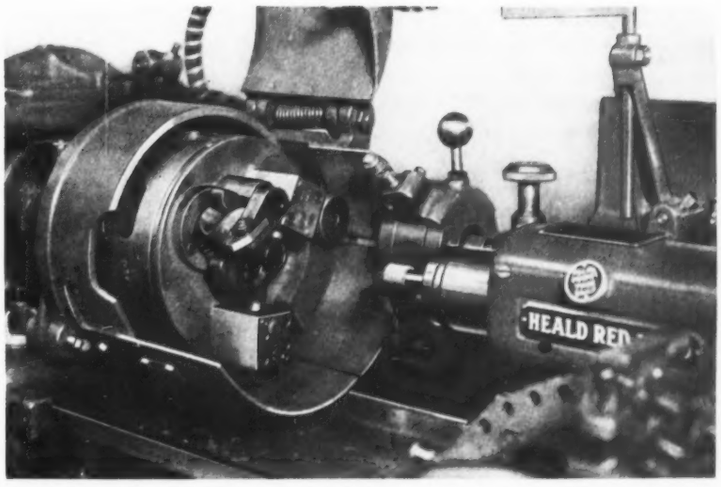
Photos, Courtesy of Heald Machine Co., Worcester, Mass.



One of the Most Important Operations in Making the Steel Valve-seat Inserts now Provided on a Number of Automobile Engines is the Grinding of the Conical Surface. The Illustration at the Right Shows a Centerless Internal Grinding Machine Being Used for this Operation in a Prominent Shop of the Industry.

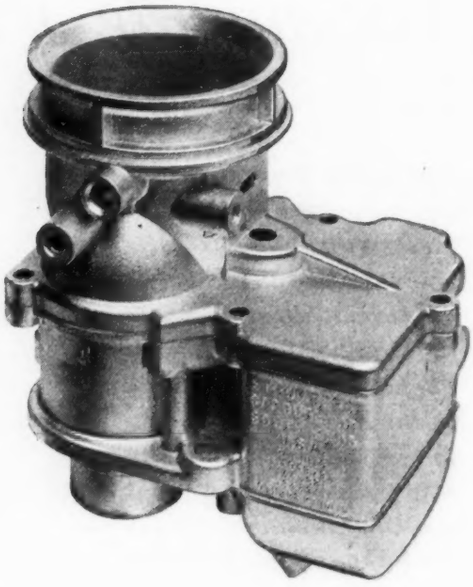


The Valve-seat Inserts Drop from the Magazine at the Top of the Centerless Internal Grinding Machine into a Holding Fixture Composed of Rolls. At the End of the Grinding Operation, the Inserts are Released and Roll by Gravity Down a Chute into a Receptacle.



Considerable Ingenuity was Required to Design a Satisfactory Fixture for Holding the Front-wheel Shaft Lever in the Grinding Operation Here Shown. The Part is Seated on an Arbor with Two Arms Located Against Accurate Blocks and it is Securely Held by Means of an Air-operated Clamp.

Die-Casting Dies that Achieve the Impossible



Carburetor Die-Castings are so Intricate in Design that Even Well Informed Mechanics and Engineers Find it Difficult to Believe that They are Produced in Steel Molds

THE automotive industry is the star customer for die-castings, both from the tonnage standpoint and from the standpoint of prestige. Every automobile is a traveling salesman for die-casting manufacturers. From fancy radiator grille and brightly shining horns to flashing tail lights, it advertises the fact that the die-casting process makes possible the economical production of articles in the fine appearance class. Under the hood are other die-castings that serve as examples of maximum utility and mechanical exactness. The carburetor, for instance, is almost always made up of die-castings so intricate in design as to make even mechanics of considerable experience wonder how they can possibly be cast in steel.

The heading illustration shows three die-castings that are important parts of a well-known carburetor, placed as though actually assembled. The main body or central casting is a fine example of the point to which die-casting manufacturers have advanced in producing complicated parts. A study of Fig. 2 will show that this carburetor part consists of thin sections, thick sections, cored holes at various angles, under-cuts, and other details of such a character as to tax the ability of the designer of die-casting dies to the utmost.

The die used in producing this part will be described in this article. The die for the upper body or air horn will be described in May MACHINERY. Both sets of dies were made by the Madison-Kipp Corporation, Madison, Wis., for use on the company's fully automatic die-casting machines.

The die for the main carburetor body opens both endwise and sidewise. It consists of two main halves, parted in line with the top face of the carburetor body (see Fig. 1). The half attached to the moving head of the die-casting machine is provided with two slides that open up sidewise. This movable die member has sliding cores which are also withdrawn from the work during the opening of the die. The details of the cavity in the movable die have been omitted in the left-hand view, so as to show the mechanisms that operate the moving cores and the two slides. Figs. 3 and 4 show this cavity, as well as the various cores on the stationary die. The stationary die is at the left and the movable die at the right.

The means for forming the cylindrical shells *W* and *X*, Fig. 2, of unusually thin section are of interest. Shells *W* are only 0.025 inch thick at the end. Each shell *W* is formed by a core *A* (Fig. 1) and a hole in die-block *B*, while each shell *X* is produced by cores *A* and *C* in the movable die and core *D* and block D_1 in the stationary member.

All four shells must be produced straight within close limits, and hence it is necessary to withdraw each pair of cores *A* and *C* from the casting before ejecting it. The cores are withdrawn by rack *E*, which engages pinion shaft *F*. Core *C* is withdrawn first from the casting, core *A* remaining stationary until the rack strikes stop *S*. Then cores *A* and *C* are withdrawn together as rack *E* completes its movement.

Pinion shaft *F*, which also engages rack *G*, is revolved as this rack is pulled upward during the withdrawal of the movable die at the end of an operation. During this die movement, a roller on shaft *H* advances along cam path *J*, which is formed by means of blocks on the vertical face of a bar mounted on top of the machine. This roller is attached to plate *K* which pivots on pin *L*. The upper end of rack *G* is also fastened to plate *K*, so that the vertical movement of the roller on shaft *H* causes a corresponding movement of rack *G*.

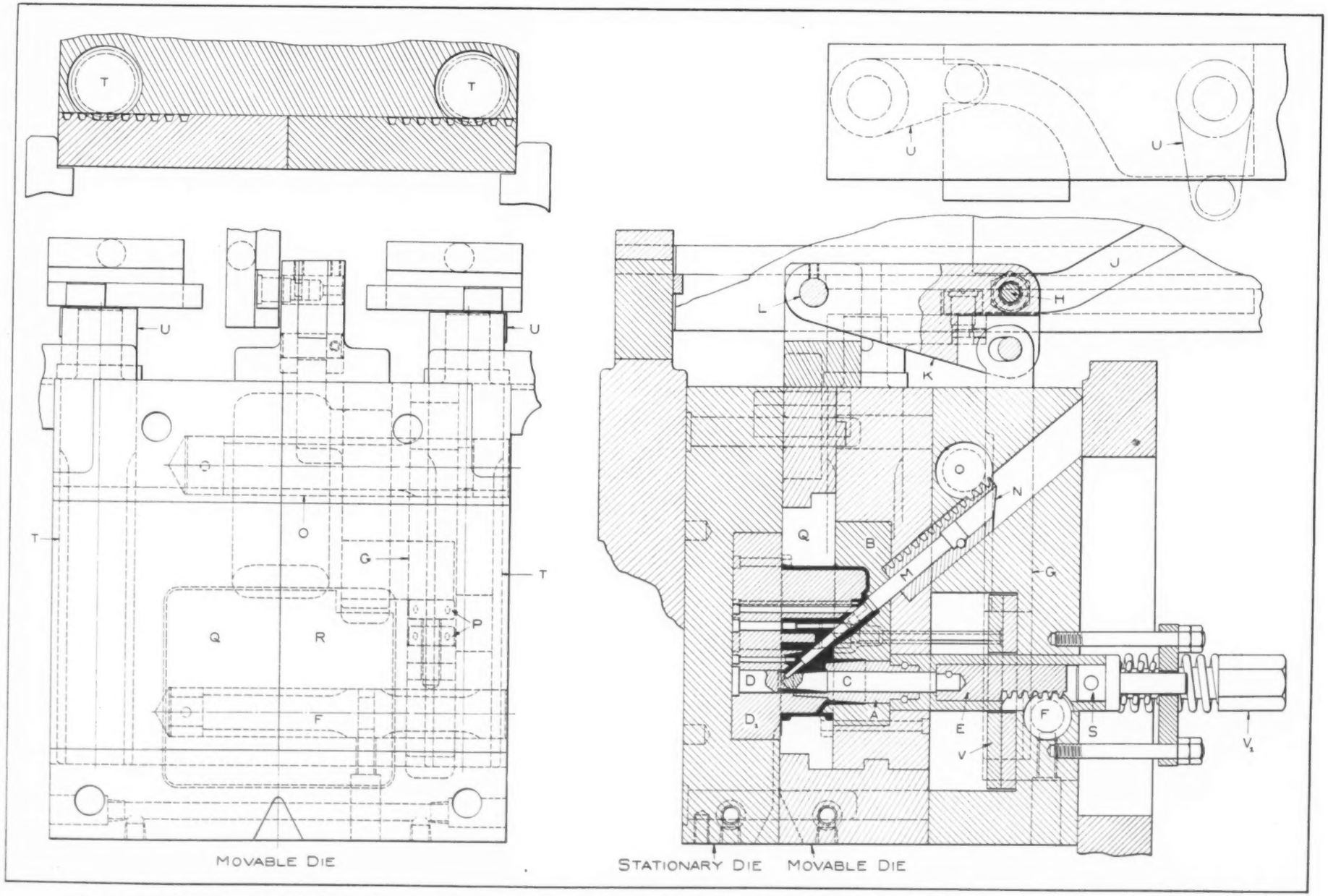


Fig. 1. Sliding Cores and Other Moving Members are Features of the Dies that Produce the Carburetor Part Shown in Fig. 2

Three sliding cores are required to produce holes *Y*, Fig. 2. Two of these holes are approximately 2 7/8 inches long and decrease in several steps from a diameter of 3/8 inch at the top to 1/8 inch at the point where they intersect holes *X*. The central hole *Y* is only about 7/8 inch long, because it is intersected by hole *Z*. The two outside holes *Y* are produced by long cores of the design shown at *M*, Fig. 1.

All three cores for holes *Y* are attached to holders of the type shown at *N*. These holders have rack teeth on one side which engage pinion shaft *O*. Shaft *O* is also actuated by rack *G* when that rack is moved upward, as already described. Rack *G*, therefore, operates seven cores.

Flash is eliminated at the points where the two holes formed by cores *M* intersect with the larger holes *X* (see Fig. 2) by extending the slender end of cores *M* into the angular faces of cores *C* and *D*. This eliminates a trimming operation on the casting, and also holds cores *M* in position to maintain a very close tolerance. Nuts *P* provide adjustment so that the different cores are operated in synchronism. In addition to the moving cores, there are a number of fixed cores on the stationary and movable dies.

The several pockets in the outside surfaces of the casting are cast by opening the movable die sidewise during its withdrawal from the stationary member. Half of the die cavity is contained in each slide *Q* and *R* (see Figs. 3 and 4). These slides join on the vertical center line of the part for the casting operation and are opened up during the withdrawal of the movable die as pinion shafts *T* turn on their axes. These pinions engage rack teeth cut on the back of each slide.

Pinion shafts *T* are rotated as the rollers attached to crank-arms *U* follow cam paths in the horizontal faces of bars located on both sides of the machine above the dies. These crank-arms are swung through approximately 100 degrees to move each slide about 1 1/2 inches. In Fig. 3, the movable die is shown with the two slides and the various moving cores in the casting position, while in Fig. 4 it is illustrated with the slides and cores withdrawn to the ejecting position. Guide bars on the stationary die insure proper closing of the slides when the movable die is against the face of the stationary member.

As the movable die approaches the end of its withdrawal stroke, the casting is ejected by four long slender pins attached to plate *V*. These pins extend through the die parts to the bottom of the cavity. Plate *V* is fastened to two studs V_1 which extend to the right of the movable die unit and contact with a bar so as to stop the movement of plate *V* as the die approaches the end of its stroke. Thus, the ejecting pins are pushed into the die cavity and eject the casting while the movable die completes its opening stroke.

When the movable die is again closed against the stationary member, the coil springs that surround studs V_1 force plate *V* into its normal position, thus drawing the ejecting pins flush with the surface of the die cavity. Ejecting pins are not required on the stationary member.

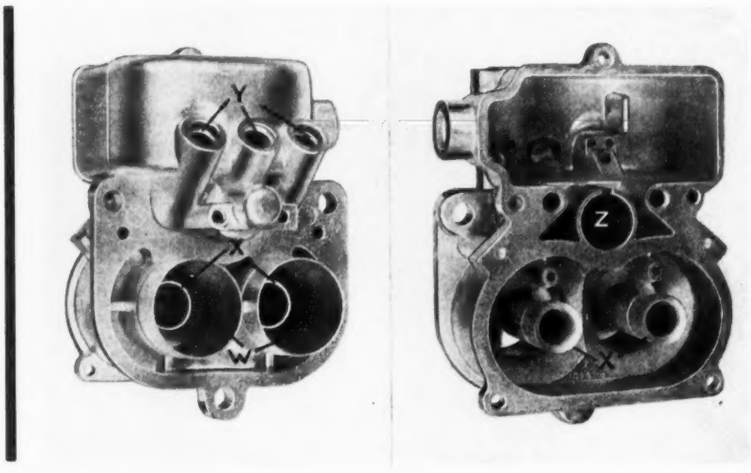


Fig. 2. Carburetor Part of Such an Intricate Design that it is Hard to Believe it is a Casting Produced in Steel Dies

Close tolerances are adhered to, so as to hold the leakage of air and the clearance between operating parts to the minimum. The size and alignment of the very small jets are also held to close limits. The gating that insures the delivery of molten metal to all parts of the die can be seen in Figs. 3 and 4. A uniform temperature of the various die members is obtained by circulating cooling water through both slides of the movable die and across the bottom of both the stationary and movable die members in the vicinity of the sprue.

This carburetor casting is made of zinc at a casting temperature of about 825 degrees F. Approximately 180 castings can be produced an hour. The castings are 3 3/8 by 4 1/2 by 2 1/2 inches over all. The dies will last, with proper upkeep of the sliding parts, for hundreds of thousands of castings, perhaps millions. The Madison-Kipp Corporation has not yet had to scrap a die designed for zinc castings.

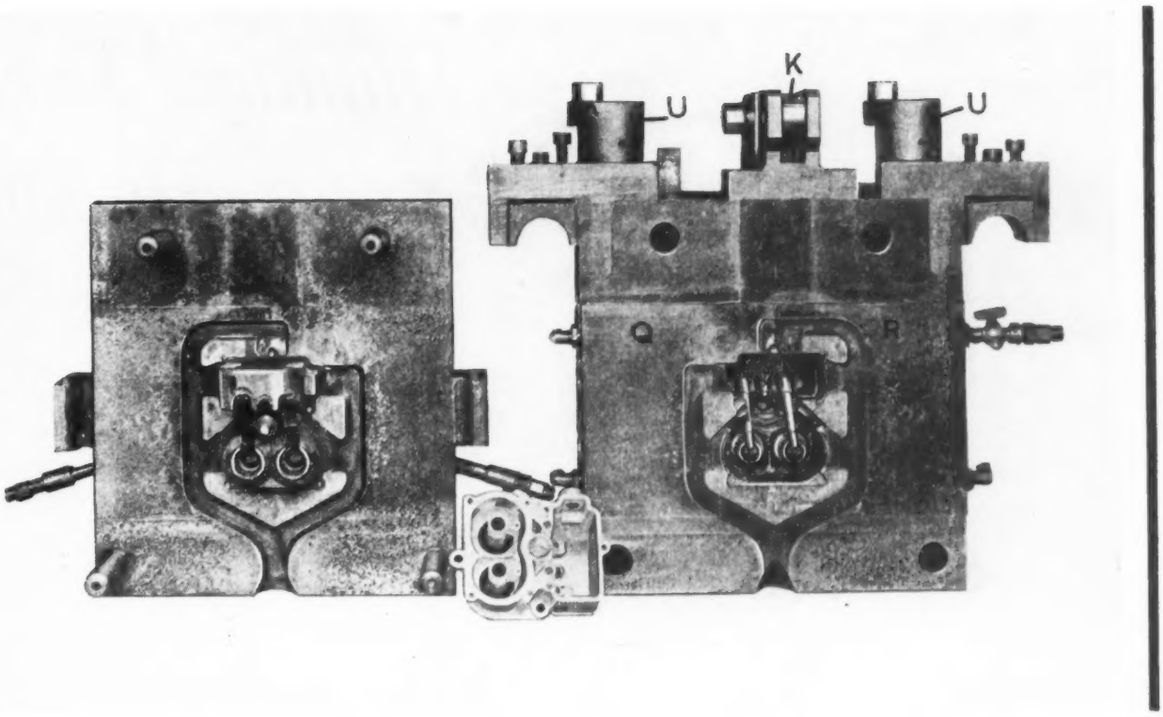
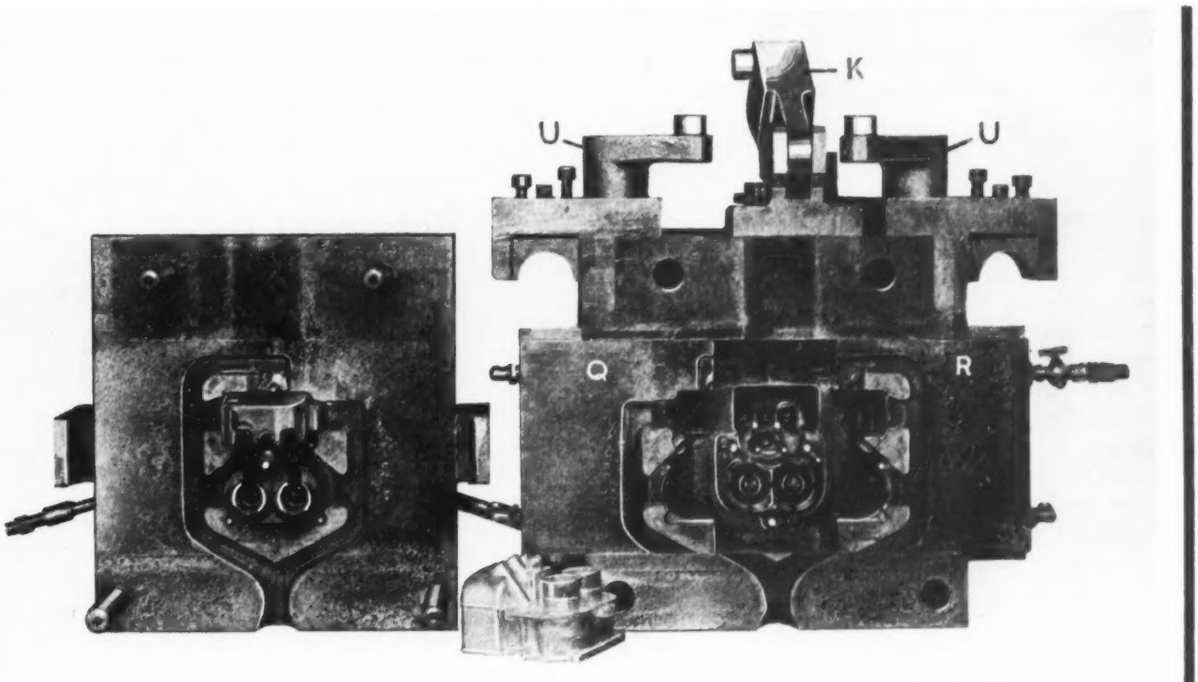


Fig. 3. Dies for Carburetor Die-casting. Stationary Die Shown at Left, and Movable Die at Right in Closed Position

Fig. 4. Carburetor Main-body Die Set with the Various Sliding Members of Movable Die in Open or Ejecting Position



Diamond Turning Automobile

The Machining of Pistons to Tool-Room Accuracy on a Mass Production Basis

BORING machines of the precision type that are designed for the accurate finishing of small and medium size holes by using diamond, tungsten-carbide or tantalum-carbide tools are widely used in the automotive industry. Their high-production possibilities, in combination with their accuracy, has led to their adoption for the finishing of pistons, connecting-rods, and transmission gears. In a number of instances, these machines have recently been successfully applied to accurate turning, and so the term "precision boring machine" has become somewhat of a misnomer. This article describes the turning and boring of automobile pistons on the hydraulically operated machines built by the Ex-Cell-O Aircraft & Tool Corporation.

Aluminum Pistons Turned Either Round or Elliptical

Automobile manufacturers have long been confronted with the problem of producing pistons of an elliptical form having a tapered skirt, this design giving better engine performance with less oil consumption and longer piston life. This operation is now being performed successfully on the machine shown on the opposite page; in the same operation three ring lands are turned cylindrically to size.

Two pistons are machined at a time by identical equipment at the front and back of the machine. Pistons that are cylindrical or have a straight skirt can also be handled by merely using a cam having the required form. This cam is mounted on the flanged nose of the work-holding spindle, as indicated at *A*, and actuates a follower mounted on the fixture that supports the tools. Diamond tools are used in this operation because of the abrasive nature of the aluminum alloy from which the pistons are made.

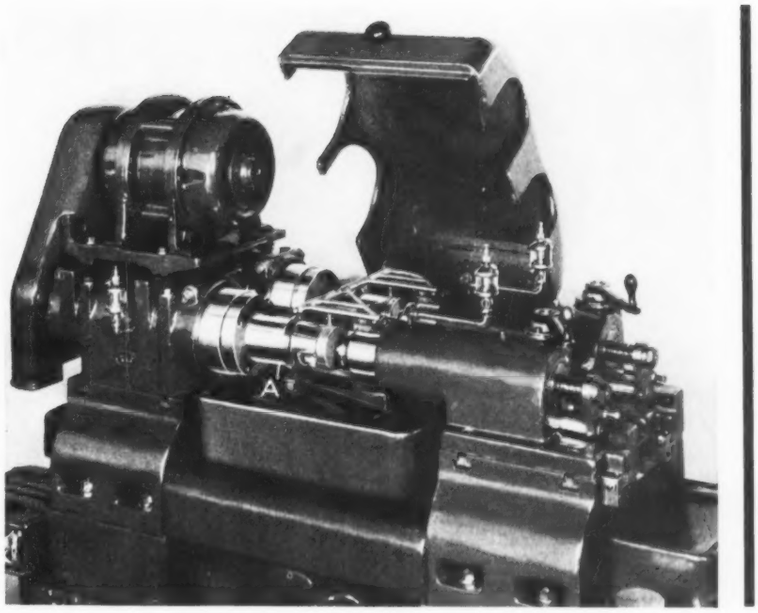
Projecting axially from the cam is a rectangular driver which fits between the piston-pin bosses on the inside of the piston. When the piston is placed over the rectangular driver, a pilot is seated in the previously machined open end of the piston and the end of the skirt is located against a shoulder on the adapter that is in front of the cam. The driver is designed to hold the piston-pin bosses in proper relation with the cam, so that the elliptical form to be machined will always have its major diameter at right angles to the piston-pin bosses. In the case of a piston with a split skirt, the driver is provided with two spring expanders that support the skirt adjacent to the slot, so as to counteract the pressure of the cutting tool. The dome of the piston is supported by a live center which is mounted in a precision bearing in the tailstock.

The fixture that carries the tools and cam follower is provided with a hydraulically operated cross-slide which advances the tools to the turning position and backs them away from the piston at the end of the cutting stroke. This avoids a drawback line from the tools being dragged across the finished surfaces. During the loading and unloading of the fixtures, the diamond tools are far enough away from the work so that they cannot be accidentally damaged.

The follower that engages the cam and the tool for turning the piston skirt are mounted on a member that oscillates on centers supported by the cross-slide. A spring holds the follower against the cam. Two tools for turning the ring lands are held in a block mounted rigidly on the cross-slide. Just ahead of the cam follower there is a spring-supported wiper with a felt pad which keeps the cam surface clean, so as to insure proper contact of the follower for the entire length of the cam. Individual micrometer adjustments are provided for setting the tools accurately.

and Boring of Pistons

By
C. A. BIRKEBAK, Engineer
Ex-Cell-O Aircraft & Tool Corporation
Detroit, Mich.



Two work-spindles are mounted on one bridge at the left-hand end of the machine, and corresponding tailstocks are mounted on the bridge at the right-hand end. The cam and tool fixture is traversed back and forth between the spindles and the tailstocks by the hydraulic equipment. A fine crosswise adjustment is provided on each bridge to insure accurate alignment of the individual spindles and tailstocks.

The cycle of the table is controlled by adjustable dogs mounted on the front of the table. These dogs operate plungers in the hydraulic unit which is located on the front of the machine just below the table. The plungers control the rapid traverse, feed, direction of travel, and automatic stopping of the table.

Coolant must be delivered to each tool during this turning operation for the full length of the cuts. To provide for this, tubes with a series of holes are placed above each piston. A valve automatically shuts off the coolant at the end of the cutting stroke and turns it on just before the next cutting cycle is started. The coolant carries all chips to the fixture pan and then to a screening and settling tank.

Advantages of Diamond Turning

The turning of pistons by using diamond tools gives a finish of unusually high quality in only one cut. This high finish, without subsequent grinding, greatly improves the quality of the bearing contact between the pistons and cylinder walls, and thus reduces initial wear. Pistons can be turned accurately to form in this way, because of the comparatively low tool pressure required. Tolerances of 0.0005 inch can be held on the major and minor diameters of the ellipse, as well as on the taper of the skirt.

Because of the uniformity in dimensions of pistons turned by diamond tools, considerable time is saved in fitting pistons to cylinder bores. Another advantage of diamond turning is that the edges of the slots in the skirts are cut sharp and clean rather than rounded. In the machine illustrated, 96 pistons are produced per hour at 80 per cent efficiency. These pistons are 3 inches in diameter and necessitate a 2 3/8-inch cutting stroke of the machine table. The depth of cut for the three tools is from 0.006 to 0.008 inch.

Typical Set-Ups for Boring Piston-Pin Holes

Fixtures and tools of different designs have been provided on Ex-Cell-O precision boring machines for finishing piston-pin holes. Production requirements vary with the plant and there are usually special conditions with respect to the pistons that must be considered. By using diamond tools on aluminum pistons and tungsten-carbide tools on cast iron, piston-pin bores can easily be held to a total tolerance of 0.0003 inch, both as regards diameter and straightness.

Two hundred cast-iron pistons are rough- and finish-bored per hour in the machine shown in Fig. 1 at 80 per cent efficiency. The depth of cut is 1/32 inch in rough-boring, and from 0.004 to 0.006 inch in finish-boring. Tungsten-carbide tools are used. The feed is 0.006 inch in rough-boring and 0.003 inch in finish-boring.

The high production was made possible by using a hydraulic pot chuck fixture with four work-holding stations, and four boring heads at each end of the machine. The pistons are placed in the fixture with the dome down. On top of the fixture there is a bracket with locator plugs that align the pistons for boring when the bracket is swung downward into position to enter the plugs horizontally into the piston-pin holes.

There is a second bracket on top of the fixture that is swung over the pistons to seat them on their

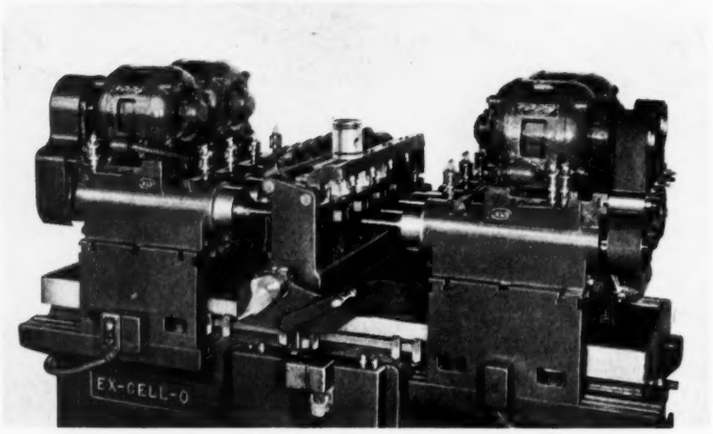


Fig. 1. Two Hundred Cast-iron Pistons are Rough- and Finish-bored per Hour in this High-production Machine, which is Equipped with a Hydraulic Fixture

dome locators by spring plunger pressure. The pistons are then clamped on the outside by means of a hydraulically operated semicircular block. After the locator bracket has been swung clear, the pistons are ready for boring. All of the fixture movements are hydraulically operated and are controlled by a six-way valve. The pistons are first carried to the left-hand spindle units for rough-boring and then to the right-hand units for finish-boring.

Lynite pistons are rough- and finish-bored at the rate of 144 per hour in the machine illustrated in Fig. 2, which employs diamond tools. This machine is equipped with a three-station hydraulic fixture in which the pistons are located on centers. At the bottom of each station is a spring center for centralizing the piston, and a swivel dome support and locator having two support pads at right angles to the swivel. When the pistons have been inserted with the dome downward and with the pin holes in the approximate location for boring, the lever on the left-hand side of the fixture is moved to operate a valve. Pressure is thus admitted into the hydraulic cylinder for pulling the upper clamping centers and V-locators downward into the pistons.

The V-locators engage the piston-pin bosses and align them accurately for boring, after which the clamps grip the piston rigidly under spring tension, holding them firmly on two-point locating plates. The lever on the upper right-hand side of the fixture is swung over to bring a swinging leaf downward. Coolant is supplied to each piston through this swinging leaf during the boring operation.

Projecting from the top of the fixture are three pins which indicate by their position whether or not each piston is so seated in the fixture that its bosses are at right angles to the line of boring. As in the preceding jobs, the rough-boring is done by units on the left-hand bridge, and the finish-boring by units at the right-hand end of the machine.

Two aluminum pistons located in steel bushings with the dome downward are simultaneously rough- and finish-bored with the equipment shown in Fig. 3. Diamond tools are used in this case also. The pistons are located by means of a hinged leaf with spring plungers which enter into the pin hole of each piston. A counterweight is provided on this hinged plate so that the locating plugs are automatically withdrawn to the open position after locating, in order to prevent damage to the boring quills.

A second hinged leaf is then swung downward, bringing two fingers into the skirt end of each piston for clamping the skirt firmly against the steel bushing. When the boring operation has been completed and the piston is unlocked, two ejecting plungers rise at the bottom of the fixture to force the pistons upward so that they can be easily removed from the fixture.

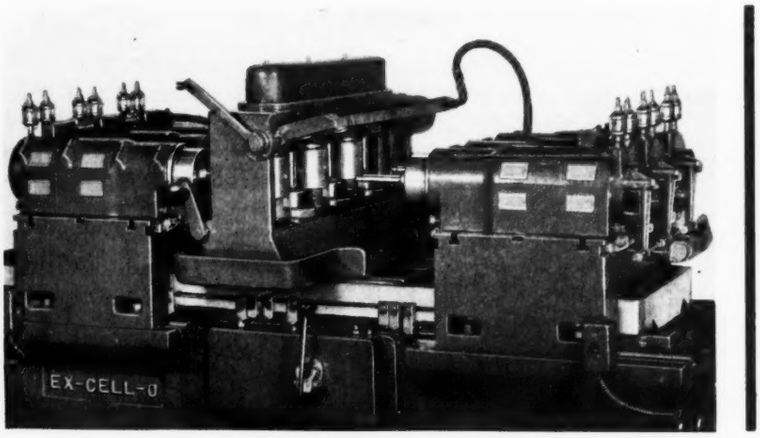


Fig. 2. Another High-production Machine Arranged with Three Boring Heads at Each End for Roughing and Finishing 144 Lynite Pistons per Hour

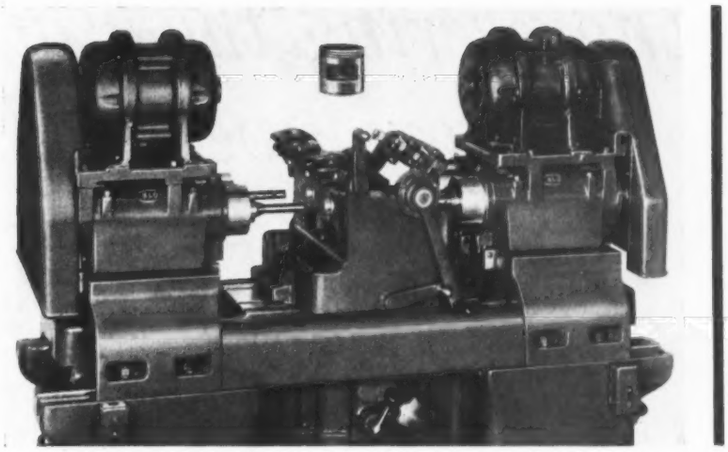


Fig. 3. Two Pistons Accurately Seated in Steel Bushings are Rough- and Finish-bored with the Equipment Shown at the Rate of 96 Pieces per Hour

In this operation, the depth of cut is about 1/32 inch for rough-boring and 0.005 inch for finish-boring. The feed for rough-boring is 0.004 inch, and for finish-boring, 0.0015 inch. Ninety-six pistons are produced per hour.

The present article has dealt with equipment intended for the quantity production of pistons. In a coming number of MACHINERY, the methods used for more limited production schedules will be illustrated and described.

Don't Follow Current Trends without Analysis

It is very easy to be carried away by a current trend in design or practice. Frequently industry will go to extremes in one direction, only to have the pendulum swing back to a more normal interpretation of a new idea at a later date. A case in point is streamlining—an artistic and a mechanically worthwhile idea, the value of which appears to have been overestimated.

A very thoughtful estimate of the place of streamlining in engineering design has been given by Alfred P. Sloan, Jr., president of the General Motors Corporation, in a statement to the stockholders. Says Mr. Sloan: "I would like to take the opportunity to point out that there is a great deal of popular misunderstanding with respect to this rather interesting subject. As a trend of design, it is finding expression in railroad cars, in airplanes, in steamships, as well as in motor cars. The popular belief is that there is a distinct gain in the general efficiency of a design embodying certain aerodynamic features.

"The operating conditions of these various instrumentalities of transportation are so different that each must be considered on the basis of its own individual circumstances, so far as the question of efficiency is concerned. As applied to motor cars, there are in reality no important economies, in the practical sense of the word, in either first cost or in operating cost. The greatest possible gain that can be expected is a somewhat higher top speed, or perhaps a slight saving in fuel at top speed, all other circumstances being the same. But, except for this negligible part of motor car travel, the contribution of streamlining is definitely limited to the question of styling.

"We hear much with respect to the new streamline trains. Here, again, there exists the popular impression that streamlining makes an important contribution toward both increased speed and increased efficiency. This is far from the truth. Actually, the factors contributing to the important progress that is being made on both these counts, as applied to transportation by rail, are reduction in size of equipment; important reductions in weight through the use of light materials; as well as an entirely different and much more efficient type of power development. The contribution of an aerodynamic design is relatively inconsequential."

In airplanes, of course, the matter is entirely different. Here the speeds are so great that the aerodynamic design becomes of primary importance, but the airplane is largely in a class by itself.

It is well to examine into new theories from time to time to make sure whether or not the pendulum has swung too far and whether popular opinion is carried to extremes. The mechanical engineer can recall many instances of extremes that have been in vogue temporarily and then settled down to a normal application. It is the designer's and engineer's job to analyze and to make sure to what extent that which is currently in vogue is also essential and important mechanically. So only can a balance between essential factors be arrived at.

Engineering the Equipment for Automotive Production

The Development of Drilling, Boring and Tapping Machines Built on the Unit Construction Principle

By H. E. MILLS,
The National Automatic Tool Co.
Richmond, Ind.

STRAIGHT-LINE production methods originated in the automotive industry. Today this industry leads in the use of highly specialized equipment for producing on a quantity, low-cost basis.

As the automotive industry developed and the production requirements became more pronounced, more and more highly specialized equipment was introduced. In an effort to reduce the cost of these highly specialized single-purpose machines, however, some of their units were standardized. The National Automatic Tool Co. began to apply standardization many years ago. Screw-feed and cam-feed drilling and tapping units were among the early developments. Later came the hydraulic unit. While these presented many advantages, they still left much to be desired as regards flexibility, a feature that gained in importance as changes in automotive design became more frequent.

Hence, it became necessary to develop flexible high-production equipment which could be changed quickly and at minimum cost. To meet this need, the company with which the writer is connected, developed self-contained, interchangeable, hydraulic drilling units and tapping units, the latter having individual lead-screw feed for each spindle.

Next came the effort to provide greater flexibility and standardization of complete drilling, boring, and tapping machine equipment. It was found that these machines could be built from five distinct component units. Referring to Fig. 2, these units are (1) hydraulic unit; (2) unit bed; (3) fixture pedestal; (4) angle spacer plate; and (5) column. By using special spindle boxes on the units and special holding fixtures, a great variety of machines can be constructed.

Fig. 2 also shows several of the most familiar combinations. No. 1 is a one-way horizontal machine composed of one bed, one hydraulic unit, and one fixture pedestal. The addition of a spindle box and a holding fixture completes the machine.

The addition of another bed and another hydraulic unit with a spindle box changes machine

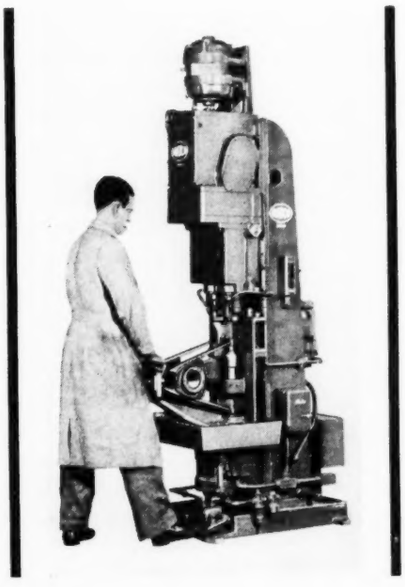


Fig. 1. Vertical Tapping Machine on which 130 Automobile Front-wheel Lower Control Arms are Tapped an Hour

No. 1 into the two-way machine No. 2. By adding an angular spacer plate, either unit can be raised or tilted as much as may be required for a new set-up. Thus we obtain the two-way machine No. 3, with one angular and one horizontal unit.

Another familiar combination, No. 4, consists of one vertical and one horizontal unit, sometimes called a right-angle machine. No. 5 is a two-way angular machine, developed from No. 3 by adding another angular spacer plate.

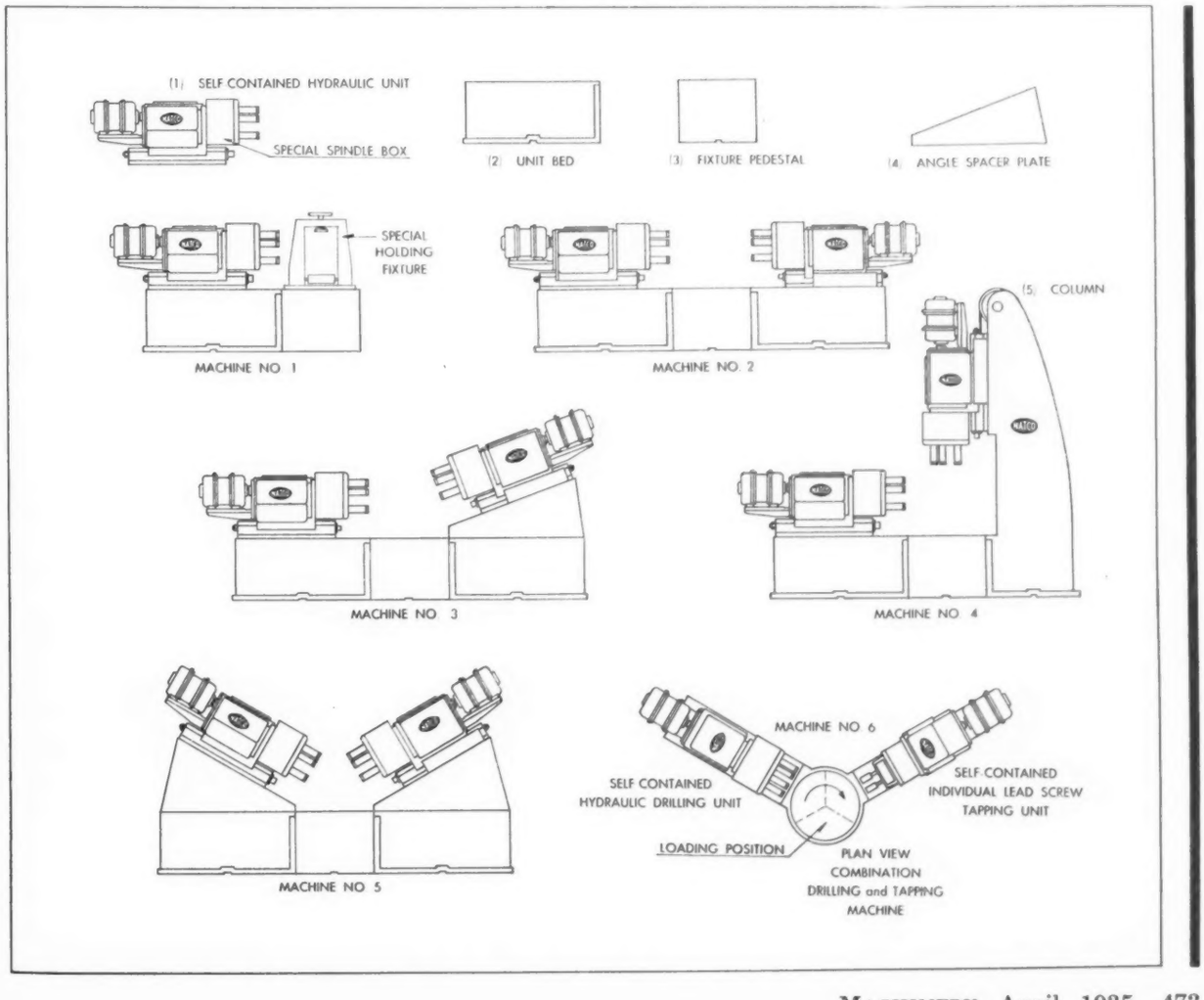
Machine No. 6 is a two-way horizontal machine built of two unit beds, a hydraulic drilling unit with a spindle box, a tapping unit with a box containing individual lead-screw spindles, and a fixture pedestal. The addition of a three-position, rotary table and three special holding fixtures completes another familiar combination, which permits drilling and tapping to be performed with a single loading. It is obvious that these units permit an almost unlimited range of combinations.

On the tapping unit, a flange is arranged at the front for the mounting of individual lead-screw spindle boxes, the unit being completely self-contained with no connections other than the electrical ones. The individual lead-screw spindle boxes are interchangeable, as are also all units of the same size.

Referring now to specific machines built for automotive production, Fig. 1 shows a vertical tapper recently installed in the plant of a well-known automobile manufacturer. This machine consists of a welded steel base and column, on which is mounted a self-contained tapping unit. Used in connection with this unit is a fixed-center gear-driven box containing two spindles with lead-screws and tap-holders. This machine has a stationary type fixture holding two front-wheel lower control arms (one left-hand and one right-hand) while one hole is tapped in each part. A production of approximately 130 parts an hour is obtained.

Often a number of operations can be combined to reduce costs. An example is shown in Fig. 3.

Fig. 2. Five Standardized Units can be Arranged to Form a Large Number of Machines, of which Six Basic Types are Shown. They can be Changed, Altered, and Rearranged at Little Cost



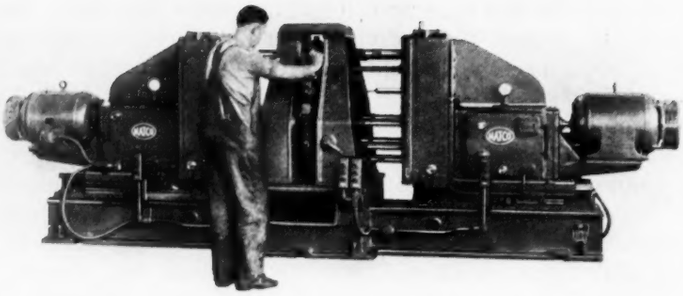


Fig. 3. The "Cross Bore" in a Shock Absorber Body is Core-drilled, Counterbored, Chamfered, Hollow-milled, and Reamed in this Two-way, Unit Construction Type Machine. The Production Obtained on this Job is Approximately 300 an Hour

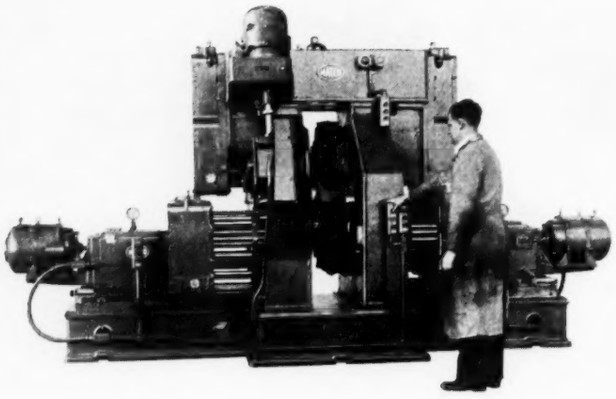


Fig. 4. Sixty-six Drilling, Counterboring, Reaming, and Tapping Operations are Performed on 70 Transmission Cases an Hour on this Machine. The Unit Construction and the Power-indexed Trunnion Fixture Permit the "Grouping" of Operations

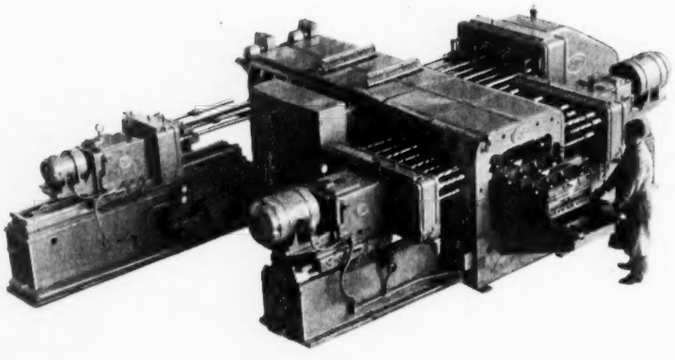


Fig. 5. A Boring Machine Consisting of Four Hydraulic Units and a Straight-line Power-indexing Fixture Performs Eighteen Core-drilling, Counterboring, Rough- and Finish-boring, and Chamfering Operations on 75 Cylinder Blocks an Hour

Fig. 6. A Two-way, Four-head Machine of Unit Construction, as Installed in the Plant of a Well-known Automobile Manufacturer for Drilling King-pin Holes in Tubular Front Axles. On this Job, a Production of 40 Axles an Hour is Maintained

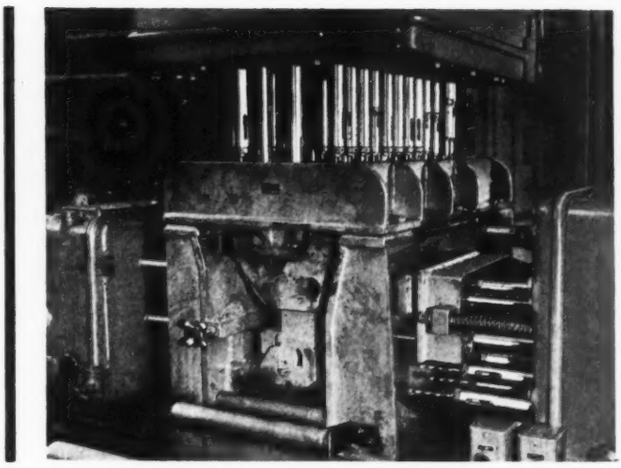


Fig. 7. A Three-way Machine for Drilling the Bottom and Two Sides of a Cylinder Block. The Three Units Drive a Total of Sixty-four Spindles

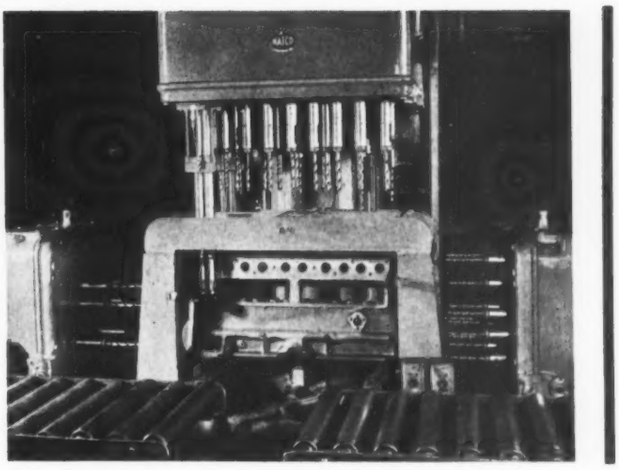


Fig. 8. Another Three-way Machine for Drilling, Countersinking and Counterboring 53 Holes in Top and Ends of 60 Cylinder Blocks an Hour

Here we have a two-way horizontal machine consisting of two hydraulic units and a six-position trunnion type fixture arranged to hold two shock absorber bodies in each position. This arrangement permits the combining or grouping of core-drilling, counterboring, chamfering, hollow-milling, and reaming operations on the "cross bore," with a single loading. The production obtained is over 300 pieces an hour.

Fig. 4 shows a machine on which a still greater number of operations are grouped. This is a two-way, four-head combination driller and tapper, built from two hydraulic units and two tapping heads driven by a single reversing-motor drive unit. In addition, there is an eight-position mechanical indexing trunnion type fixture, which holds one transmission case in each position. A total of sixty-six drilling, counterboring, reaming, and tapping operations are performed on 70 transmission cases an hour with this machine. The trunnion fixtures in Figs. 3 and 4 are hand and power indexed, respectively.

Another method was used to move the work through the two-way, four-head machine shown in

Fig. 9. A Two-way, Four-head Machine with a Mechanical Indexing Fixture for Drilling, Counterboring, Chamfering, Reaming, and Tapping 70 Crankshafts an Hour

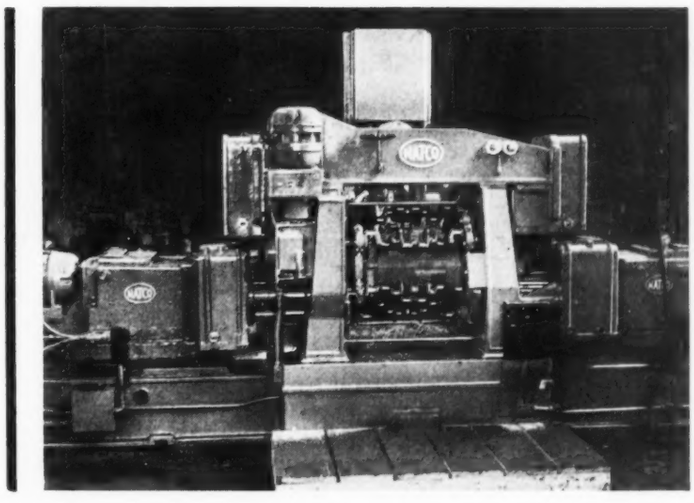


Fig. 10. A Two-way Angular Machine for Drilling Five Oil-release and Oil-lead Holes in 40 Cylinder Blocks an Hour

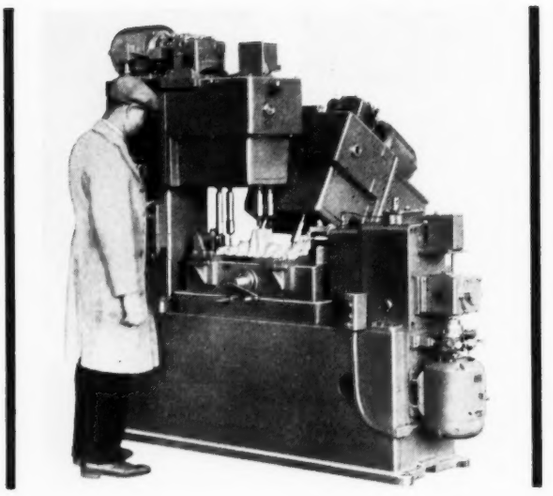


Fig. 11. Three-way Tapper Tapping Holes in an Aluminum Valve-chamber Cover at the Rate of 250 Pieces an Hour

Fig. 5. This machine consists of three self-contained hydraulic units and a hydraulic boring unit, and has a seven-position, straight-line power-indexing fixture arranged to hold two cylinder blocks in each position. This machine performs a total of eighteen operations consisting of core-drilling, counterboring, rough- and finish-boring, and chamfering on the welsh-plug and cam and crank bores of approximately 75 cylinder blocks an hour.

Fig. 6 shows a two-way four-head machine consisting of four hydraulic units. Used in connection with this machine is a stationary type fixture arranged to hold one steel tubular front axle while the king-pin holes are drilled. A similar machine is being used by the same manufacturer for counterboring and reaming the holes after the drilling operations. A production of 40 axles an hour is maintained.

Another method of cylinder-block drilling is shown in Figs. 7 and 8. Fig. 7 is a close-up view of a three-way drilling machine made up from hydraulic units. This machine drills a total of sixty-four holes in the bottom and two sides of the block. The machine shown in Fig. 8 is built from three hydraulic units and drills a total of fifty-three holes in the top and two ends of the block. The production obtained by this machine is approximately 60 blocks an hour.

Fig. 9 shows another two-way, four-head combination driller and tapper used by a prominent automobile manufacturer for drilling, counterboring, chamfering, reaming, and tapping both ends of a forged steel crankshaft. The work passes from one tool to another by means of a six-position trunnion type mechanical indexing fixture. This machine is built from two hydraulic units with spindle boxes, and two tapping heads driven by a single reversing-motor drive unit. This machine performs thirty-seven operations on about 70 crankshafts an hour.

Another application of the hydraulic unit is shown in Fig. 10. Here is a two-way machine arranged with one unit mounted in a vertical position and one in an angular position, both equipped with the required spindle boxes. A stationary fixture holds one cylinder block while the vertical head drills an oil-release hole in the bottom of the block and the angular head drills four oil-lead holes at an angle. These operations are completed on 40 cylinder blocks an hour.

Fig. 11 shows a three-way individual lead-screw tapper for tapping all the holes in an aluminum valve-chamber cover. Each head of the machine is driven by an individual reversing-motor drive unit. The machine taps five holes in the top face, two holes in the angular face, and one hole in the end of 250 pieces an hour. The cover is located in a stationary fixture by two previously reamed holes.

In an effort to make possible the rapid drilling of deep holes, a so-called "step-drilling attachment" has recently been developed for application on the hydraulic drilling units. A unit so equipped is shown in Fig. 12. Many of these units now in operation have proved themselves capable of drilling holes much more rapidly than could formerly be done—in some instances, in one-fifth of the time previously required.

The examples of combinations of units shown in this article indicate an important trend in advanced machine tool design. This trend has contributed greatly to the successful solution of the problem of the special versus the standard machine.

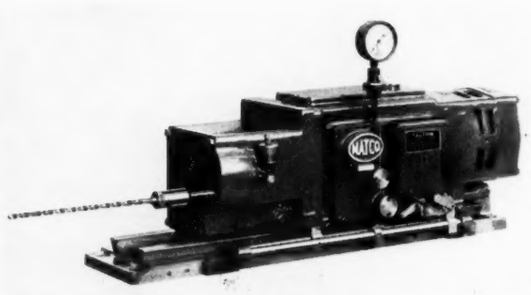


Fig. 12. A Self-contained Hydraulic Unit Equipped with a "Step-drilling Attachment" for the Drilling of Exceptionally Deep Holes. This Unit Operates at Any Angle and Without Mechanical Connections

Grooving 2800 Piston-Rings an Hour

Annular Oil-Grooves of V-Shape are Simultaneously Roughed and Finished on Thirty-Three Piston-Rings

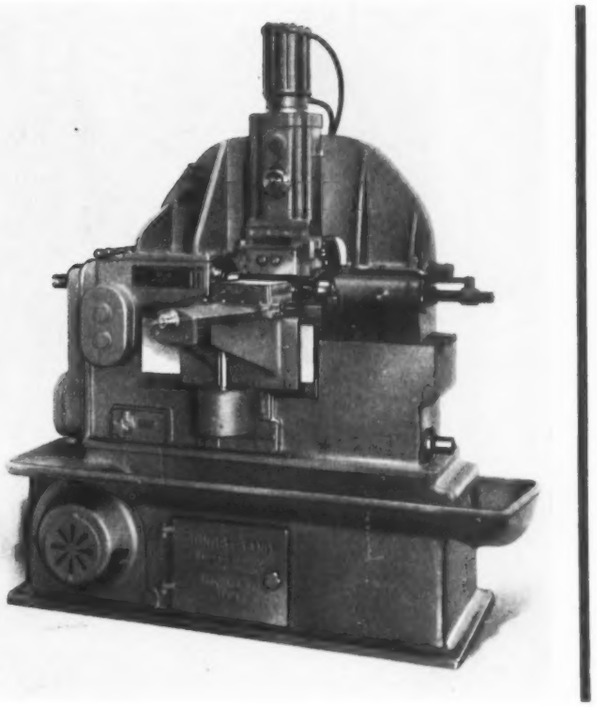


Fig. 1. Piston-rings are Grooved at High Production Rates in this Sundstrand Stub Lathe

OIL-GROOVES are cut to a V-shape in the periphery of cast-iron automobile piston-rings on the Sundstrand Stub lathe here illustrated. This operation has been performed at the rate of 2800 piston-rings an hour, based on an efficiency of 100 per cent. At 85 per cent efficiency, the production would be about 2300 rings an hour, or 38 rings a minute.

Roughing and finishing cuts are taken on thirty-three piston-rings simultaneously. The rings come to the machine finish-ground on both sides and turned to the specified outside diameter, but not split. They are assembled on arbors of the type shown in Fig. 2 by employing three spacer collars and a special nut which engages a thread of fine pitch on the arbor. The threads are interrupted at three places on both the arbor and in the nut in the manner of gun breech-blocks, so that with a one-third turn, the nut is tightened in position on the arbor or loosened.

The loaded arbor is placed between the centers of the lathe, as shown in Fig. 3, and the tailstock quill is locked to hold the tailstock center in the advanced position. When the clutch is engaged, the work starts rotating and the overhead tool-slide is rapidly lowered into engagement with a feed-cam by a pneumatic cylinder. In addition to the overhead slide, there is a tool-slide at the front of the machine and another at the rear. All three slides are equipped with thirty-three tungsten-carbide tipped tools, and they are fed simultaneously to the work.

The overhead slide is fed vertically in line with the arbor center line for the rough-turning of the grooves; the front slide is fed at an angle toward the center of the machine for finish-turning the right-hand side of the grooves; and the rear slide is fed at the same angle toward the center of the machine for finish-turning the left-hand side of each groove. Upon the completion of an operation, the tools dwell momentarily and the three slides are then rapidly returned to their starting positions while the spindle is brought to rest. In order to obtain maximum production with this equip-

Fig. 2. Thirty-three Piston-rings are Held on Arbors of the Type Here Illustrated for the Double-angle Oil-grooving Operation

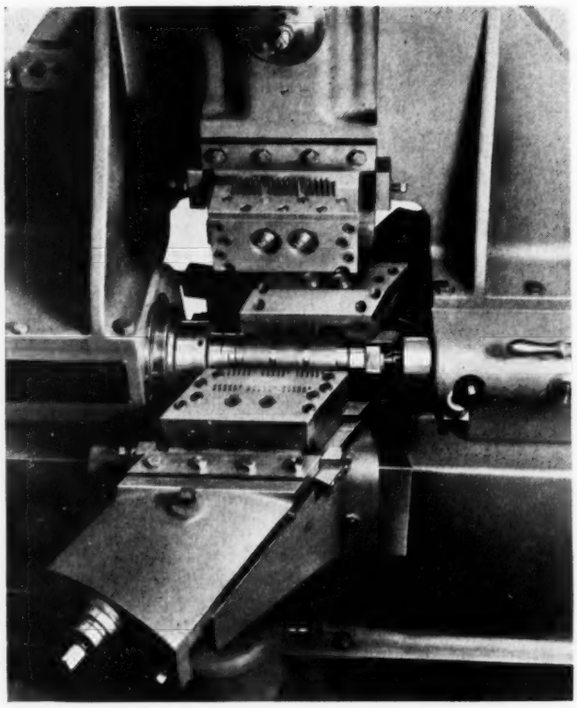


Fig. 3. Three Slides Equipped with Thirty-three Tools Each Take Roughing and Finishing Cuts in Producing the Piston-ring Grooves

ment, one man operates the machine and a helper loads and unloads extra arbors.

Considerable pressure is required to hold the piston-rings securely enough to make them revolve with the arbor, but the arbor construction meets this requirement satisfactorily. Another important requirement in the operation is the close tolerance specified on the width and depth of the grooves. The overhead slide is fed 0.0028 inch per revolution, and the other two slides 0.0017 inch. The work revolves at a surface speed of 125 feet a minute. Air is utilized to raise the overhead slide quickly into the loading position and to lower it into the cutting position, because of the considerable distance through which it must be moved.

Nickel-Chromium Cast Iron for Cylinder Blocks

By ROBERT CASS, Engineering Secretary
White Motor Co., Cleveland, Ohio

After a long period of development work on cast iron, the White Motor Co. arrived at an analysis which gives an increase of many thousands of miles of service, as compared with the cast irons formerly used in the automotive industry. The composition of this nickel-chromium-manganese cast iron is as follows: Silicon, from 1.8 to 2 per cent; manganese, from 0.45 to 0.60 per cent; sulphur, 0.12 per cent, maximum; phosphorus, from 0.15 to 0.25 per cent; nickel, from 0.25 to 0.50 per cent; and chromium, from 0.40 to 0.70 per cent. The Brinell hardness varies from 201 to 229, and the scleroscope hardness in the bore is 40.

The graphite content, by the use of nickel and chromium, is maintained in a very fine and uniform condition and is responsible, in a large measure, for the fine wearing surface that it is possible to secure in the initial machining operations and to maintain in actual service. While it would be possible to increase the Brinell hardness of the cylinder blocks, it is felt that such increase might adversely affect the rate of wear of the piston-rings, and so would increase the over-all maintenance cost of the engine. Under good maintenance and oil conditions, the wear is frequently but a few thousandths inch, even after 75,000 to 100,000 miles of operation, and represents a distinct improvement in cylinder block wear over the earlier cast irons that did not contain nickel and chromium, or the finely divided and uniform graphite that it is possible to obtain with this analysis.

This iron has uniform machining properties; it will take a very high finish, and the final honing operation to which the blocks are subjected produces a mirror finish.

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How Automobile Prices are Reduced

Every automobile consists of thousands of separate and distinct parts, so that if only a slight saving can be made in the manufacture of most of these parts, the total saving on the entire car reaches a respectable figure. It is the minute study of each separate part that has made it possible to achieve present results. Not a reduction of several dollars on a comparatively small number of big parts, but the small savings on a very large number of pieces is what counts. As one equipment engineer said, "It is a dime here and a nickel there that reduces the price of a car $200."

Buses Assembled on Overhead Tracks

Increasing Demands for City Buses Led the White Motor Co. to Adopt Assembly Methods Suited to Their Peculiar Construction

THROUGHOUT the automotive industry, conveyors that run along the floor are universally employed for assembling automobiles, buses, and motor trucks. It is the common practice to mount the chassis on the conveyor at the starting end and then progressively add the many other units and parts that make up the final car or truck.

Conveyors of the conventional type are employed by the White Motor Co., Cleveland, Ohio, in assembling motor trucks and buses of the inter-city or long-run type. However, buses of the style that have become popular for city service (one of which is shown in the heading illustration) are made with the chassis integral with the bus body. This construction makes it difficult to assemble the engine, front and rear axles, transmission, and other units while the body is carried along by a floor type conveyor. The only convenient method is to assemble most of the units and parts from underneath.

To meet this condition, the concern recently established an assembly line in which the buses are suspended from overhead tracks. Unusual accessibility is provided by this method.

The bus bodies reach the beginning of the assembly line on dollies, which are used to bring them from the Bender Body Co., also of Cleveland, where they are fabricated. When delivered to the White plant, the bodies and their under structures, or chassis, have been given a prime coat of paint. Windows, lighting fixtures, seats, flooring, and all such equipment are supplied after the buses have been provided with all the operating units and are returned to the Bender Body Co. under their own power.

At the beginning of the assembly line, two twin type chain hoists attached to the roof girders are employed to lift the bus body from the dolly. It is held suspended by these hoists while long hooks that hang from eight-wheel trolleys are swung into the openings in the sides of the bus that provide clearance for the wheels. The construction of these hooks may be seen in Fig. 1. Long rods passed through the bus windows are used to tie together the hooks on opposite sides of the bus so as to prevent them from working loose and causing an accident. Heavy rubber pads on the holding mem-

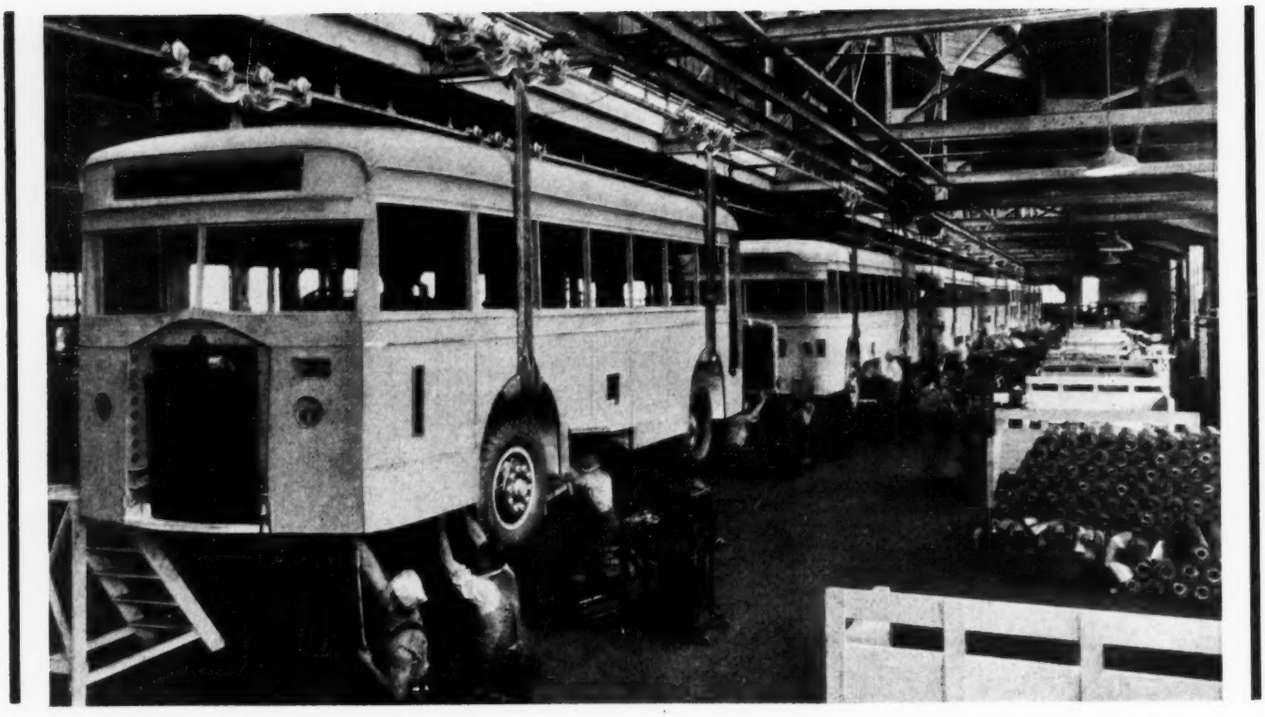

Fig. 1. City Buses Being Assembled Complete while the Bus Bodies are Suspended from Overhead Tracks at the Plant of the White Motor Company

ber of the hooks prevent the bus from being marred by this method of handling.

When the hooks have been attached, the bottom edge of the bus body is approximately 4 1/2 feet above the floor. The trolleys to which the hooks are attached are of roller bearing design, so that the buses can be readily pushed by hand along the overhead tracks as the assembly progresses.

The various units and parts required for these buses are sent directly from the production departments to the assembly line. Here they are stored in the proper sequence in the bins seen in Fig. 1. This arrangement eliminates the necessity of a separate storage room and facilitates keeping a close check on the number of units on hand. Such a check is made twice a day by a "stock expediter."

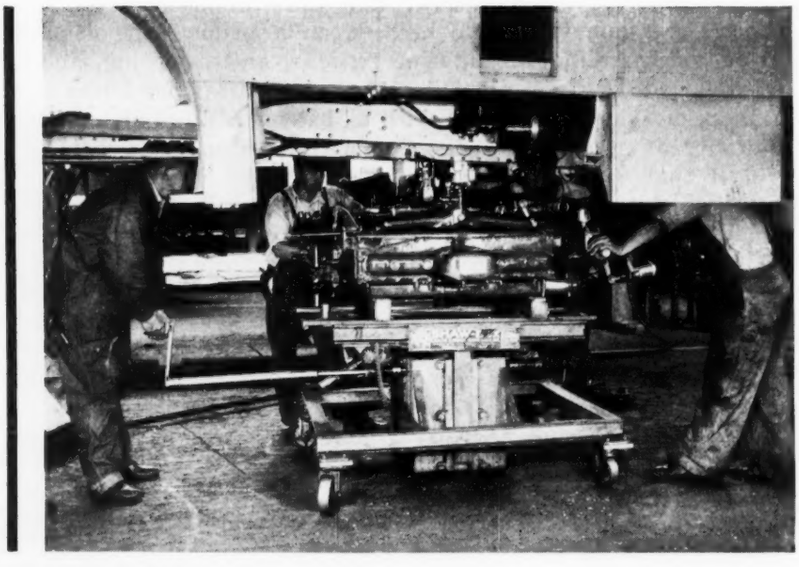

Fig. 2. Raising the Pancake Type Engine of White City Buses into Position to be Assembled by Means of an Elevating Table

Fig. 4. Hydraulic Lifts of 24,000 Pounds Capacity Raise the Buses from the Floor for Convenient Inspection after Road Tests have been Made

Some parts are prepared adjacent to the assembly line, pipes being cut to length, for example, and a few units being wired.

The first step in the assembly of these buses consists of attaching various wires and pipes. Then such parts as gasoline tanks, splash shields, and accessory housings are assembled. These are followed by such equipment as air tanks for controlling the brakes, brake and operating levers, brake boosters, the propeller shaft brake, and the steering gear. Next, the steering and throttle control mechanisms, exhaust pipes, muffler, motor-support brackets, oil reservoir tanks, and other parts are attached. Large-sized "kiddy cars" have been provided to aid the men in moving about beneath the buses while in a sitting position.

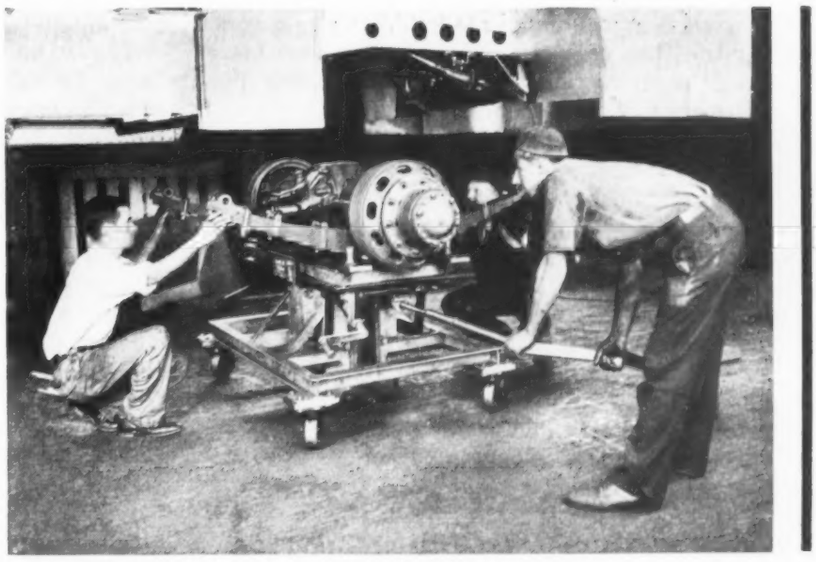

Fig. 3. Another Hand-operated Elevating Table Being Used to Position the Front-axleAssembly at Proper Height to be Installed

Elevating Table Aids in Assembling the "Pancake" Engine and Other Heavy Units

The twelve-cylinder "pancake type" engine with which these buses are equipped weighs approximately 1380 pounds without the clutch and the transmission unit. The assembling of this heavy engine to the truck body is facilitated by the use of the elevating table illustrated in Fig. 2. This table is raised by turning a hand-crank until the engine has been positioned at the proper height to be fastened to the body frame. The engine is lifted on this elevating table by means of a chain hoist on the boom of a jib crane located adjacent to the assembly line. The front- and rear-axle assemblies are raised to the height of the bus body by employing a similar elevating table, as shown in Fig. 3.

After these units have been assembled, the accessory drive, radiator, wheels, throttle, shifter rods, etc., are added and the various connections are made to the instrument panel. Oil and gasoline are then provided, the bus is greased completely, and the final adjustments are made. The bus is now lowered to the floor by means of chain hoists, the battery is installed and the bus is driven from the assembly line under its own power. It is then sent to the Bender Body Co. to receive the furnishings of the bus body and to be painted.

The total length of the assembly line is 294 feet. Seven buses can be handled on the line at one time. The number of assemblers varies with production schedules.

Hydraulic Lifts Facilitate Inspection

When the body has been fitted out and painted by the concern mentioned, the bus is returned to the White Motor Co. for road tests and final inspection. The final inspection is conducted in the department illustrated in Fig. 4, where two heavy-duty hydraulic lifts of a twin post design have been installed for lifting the buses until the wheels are about 5 feet above the floor. This enables a clear view of the entire operating equipment to be obtained. The posts of these lifts are fitted with holding devices to suit the front and rear axles.

Each lift has a capacity of 24,000 pounds. They were installed by the Weaver Mfg. Co., Springfield, Ill. One of the particular features of these lifts is that the front post is adjustable horizontally to suit various wheel-base lengths. Wheel bases from 8 1/2 to 17 feet can be accommodated. Both posts have a diameter of 10 5/8 inches.

Castings Take the Place of Forgings in Automotive Practice

Cast crankshafts are now regularly used on at least one make of automobile. These crankshafts are produced from an alloy high-carbon steel with a high copper, chromium, and silicon content. The minimum elastic limit in torsion of this metal is equal to that of the forged steel formerly used. It is claimed that the new crankshafts have a much longer life than forged crankshafts, possess better bearing properties, and have self-lubricating qualities because of the graphite content in the cast metal. There is less wear on the journals and in the bearings.

Cast-iron camshafts were used on only one 1933 automobile. In 1934 they were used on at least three makes. The minimum tensile strength of the camshaft metal is 50,000 pounds per square inch, and tensile strengths of from 60,000 to 80,000 pounds per square inch are claimed for the grades of this metal that are used in the production of crankshafts.

Automobile brake-drums, cylinder sleeves, and liners are being cast from a low carbon-chromium alloy that is produced in the electric furnace. A higher tensile strength than that of ordinary cast iron and exceptional wearing properties are characteristic of this alloy. An alloy cast iron is also being used for the exhaust-valve seat inserts in one automobile.

The value of nitrogen-hardened cast-iron cylinder liners, both in stationary and automobile gasoline engines, has been demonstrated by experiments made in England. Nitrogen-hardened cast-iron cylinder liners stood up for nearly six times the mileage, per 0.001 inch of wear, obtained with regular nickel-chromium cast-iron cylinder liners.

Dies made of alloy cast iron are being used extensively in automobile shops for sheet-metal forming operations, the composition being varied according to whether the castings are to be used for small dies that can be conveniently heat-treated or for dies too large for heating and quenching with the usual equipment.

Simplifying the Machining of a Complicated Diesel Engine Part

SCAVENGER pumps on the Diesel engines used for driving modern streamline trains are fitted with impellers of such design as to present an unusual machining problem. They are cast of an aluminum alloy, and must be finished all over to the shape shown at *A* in Figs. 1 and 2. The impeller is 12 inches outside diameter by 12 inches long.

Each impeller has three helical lobes or teeth, of which the portion above the pitch line (the face) and the portion below the pitch line (the flank) are parts of cylinders. It will be apparent that the faces are convex and the flanks concave. In each lobe, there is a cored hole that is accurately counterbored at one end.

The Hy-Draulic shaper-planer built by the Rockford Machine Tool Co., Rockford, Ill., was found to be particularly adapted for machining these impellers if means were provided for swiveling the work during each table movement in order to machine the part to the desired helix. The illustrations show the equipment developed for this purpose. Impellers up to 30 inches in diameter by 35 inches long can be handled.

For the operation, the impeller is supported between a headstock *B* and a tailstock *C*. The headstock is provided with a faceplate *D* (see Fig. 2), which has an adjustable stud mounted on it. This stud locates and drives the work by engaging the machined counterbore in one of the lobes. A helical-gear segment on the back of the faceplate meshes with a rack in the extended base of the headstock.

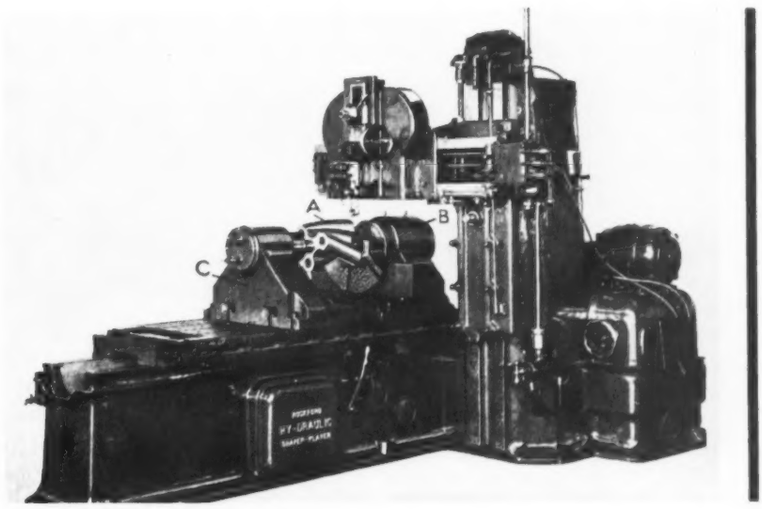

Fig. 1. Rockford Hy-Draulic Shaper-Planer Machining a Pump Impeller of Unusual Shape for Diesel Engines

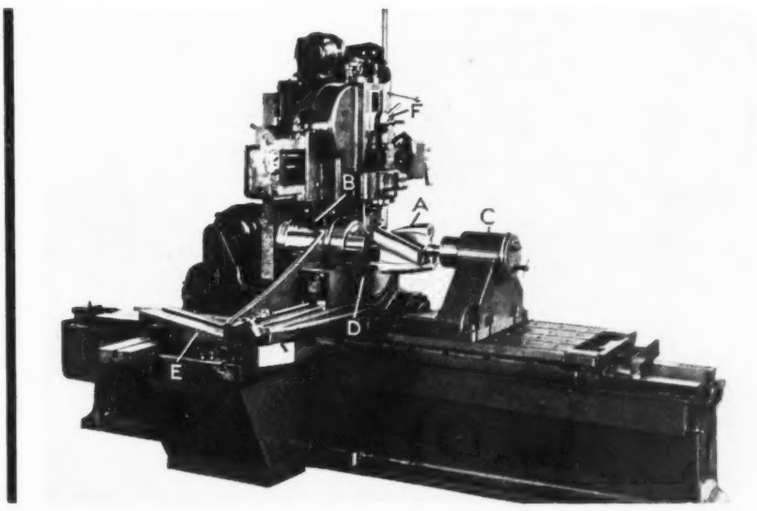

Fig. 2. View Showing the Mechanism that Swivels the Pump Impeller as the Table Moves Back and Forth

Attached to the outer end of this rack is a block which slides in a dovetailed groove in sine bar *E*. The sine bar is pivoted at the center on an extension of the bed, so that it can be positioned to different angles in relation to the line of table movement. As the block fastened to the rack moves along the sine bar with the reciprocations of the table, it imparts a movement through the rack to the helical-gear segment of the faceplate, and causes the work to swivel on its axis. The angular position of the sine bar, of course, establishes the pitch of the helix obtained in this manner, and determines whether it is right-hand or left-hand.

The cutting tool is circular in shape. It is carried on a special head mounted on the cross-rail, and is positioned directly over the center line of the impeller for cutting. The hydraulic feed of the shaper-planer actuates worm-gearing between the table movements to rotate a slotted disk on which there is an adjustable wrist-pin *F*, which governs the up and down movements of the cutting tool. When the wrist-pin is set above the center of the slotted disk, the tool machines the face or convex portion of a lobe. For machining the flank or concave portion of the lobes, the wrist-pin is moved a suitable distance below the center of the slotted disk.

The impeller is indexed six times during the operation by an index-pin and clamping screw on the tailstock. The face of each lobe is machined separately in two cuts, one for roughing and the other for finishing. The work is indexed 120 degrees for machining the respective lobes. Then the work is indexed 60 degrees for finishing the adjacent flanks of two lobes, and the other flanks are machined after subsequent indexings of 120 degrees each. Two cuts are also taken on each flank.

The impeller shown was machined in ninety minutes, floor-to-floor time. Considering the nature of the job, this is a high-speed performance. The machining time, no doubt, will be reduced substantially as the operator becomes more familiar with the job.

A high grade of finish is obtained on these impellers, due to the fact that the hydraulic table drive and hydraulic feed function so smoothly as to eliminate chatter. The machine was also supplied with a standard cross-head and side-head which can be substituted readily for the special equipment to adapt the machine for a wide variety of work.

Rubber Contributes to Quiet Operation of Automobiles

The quiet operation so noticeable in many new automobiles has been made possible largely by the increased use of rubber. In 1925, about three pounds of rubber were used for parts other than the tires and tubes, whereas now cars often have rubber parts totaling from 30 to 40 pounds in weight, and many of the current models are using even greater amounts. Quieter running engines, tires, and other units have made it necessary to introduce rubber insulation at various points to reduce body noises formerly drowned out by the engine and tire noises. The rumbling or drumming noise so objectionable in the first all-steel bodies is now broken up effectively by means of rubber insulation. The advantages of rubber engine mountings are also realized by power boat builders, as well as by automobile manufacturers.

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How the Automotive Industry Has Led the Recovery

Thanks to the time, money, and research that manufacturers have devoted to the problem of creating buying desire, a great stimulation is noticeable today. Back in the slowest and dullest days, research departments kept right on the job. To develop new products and make refinements on the old—that was their aim. They knew they couldn't count on the "obsolescence" or "replacement" factor to keep them busy enough. "We must create new buying desire," they said. A glance at the automobile industry alone is enough to illustrate this point. The auto men, at least the wise ones among them, tightened their belts, tucked in their chins, and went to work to develop a car that the public wanted to buy—wanted to buy, in fact, with eager anticipation, like children enthusing over new toys.—*N. A. Woodworth in Tool Tips*

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Importance of Good Piston Fits

The importance of the piston fit in an automobile engine cylinder, as it affects long life and smoothness of operation, is not generally appreciated, says Thomas Howe in the *Ford Dealer and Service Field*. If a piston fit is too loose, we have the equivalent of a "worn out" piston before the car leaves the factory. If the piston is fitted 0.0005 inch too tight, the frictional heat developed—even if it does not score the cylinder wall—tends to expand the piston. Hence, the extra force required to draw the piston up and down in the cylinder throws the motor out of balance.

Trends in Automotive Bearings that Apply in General Machine Design

By HERBERT CHASE, Consulting Engineer

AMONG the recent developments in automotive bearings are several new types or designs that have interesting possibilities, not only with respect to their further application in this field, but also as regards their application to machinery in general. In fact, some of the bearings developed specifically for automotive use are already being used to advantage in machines and products of other industries. Though no strictly new principles may be found in the design of these bearings so far as operation is concerned, some of them are produced by new methods and have important advantages over some of the older designs or types.

Although needle bearings are often referred to as a European development, they were used for the valve rockers on Franklin automobile engines long before much was known about European applications. According to the Bantam Ball Bearing Co., one of the largest producers of this type of bearing, known as the Quill bearing, the extensive use of these bearings was made possible by experience gained in producing rollers for free-wheeling devices. The first rollers used in the free-wheeling devices were made so hard, in order to withstand wear, that they often fractured or crushed under shock loads. To overcome this weakness, a special heat-treatment was developed to give adequate hardness combined with sufficient ductility to insure satisfactory service. The same or a very similar treatment has proved excellent for needle bearings.

The needle bearings referred to here may be described as a form of a straight roller bearing, in which the rollers are quite long in proportion to their diameter. These bearings may or may not have cages or races.

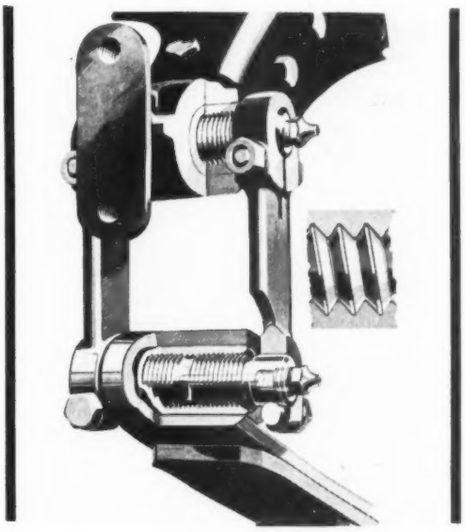


Fig. 1. Threaded Shackle Bearing Having Oil Space as Shown by Enlarged Section

Needle Bearings Solve Lubrication Problems

An important consideration in the use of needle bearings is that, in some installations, notably on the trunnions of universal joints, the bearing can be packed in grease to provide sufficient lubrication for its entire life—or, presumably, for the normal life of the car. This installation has proved of great advantage over plain bushings, which were very difficult to keep lubricated and which were prone to failure as a result of poor lubrication and shock loading. Success in this application led to other uses, especially in automobile gear sets for mounting the countershaft gears. Here the needle bearings function as satisfactorily as more expensive antifriction bearings, yet they can be used in a space no larger than that allotted to the plain bushings frequently used. These qualities, available at low cost, were responsible for extending the use of the needle type bearing to the pilot bearing, second-speed idler gear, and to lay shafts on multi-speed truck transmissions.

Improved methods for producing rollers of small diameter were developed by the Bantam Ball Bearing Co. to meet the increasing demand for Quill bearings. As a result, rollers of high-quality material now sell as low as $1 per thousand when made to a tolerance of $\pm$ 0.0002 inch on the diameter in sizes under 3/32 inch, or to a tolerance of $\pm$ 0.0001 inch on larger sizes in large volume. The Rockwell hardness of the Quill bearings on the "C" scale is held within limits of 57 to 60, and the ductility must be such as to allow a 10- to 20-degree set before fracturing, depending on the diameter.

Quill bearings have been applied recently to various joints in the new Dubonnet type of independent wheel suspension on Chevrolet and Pontiac cars, to the joints in the Hudson "Axleflex" axle, and to the kingpins on the Chrysler Imperial and Chevrolet cars. Other recent applications include gear sets on Plymouth and Dodge cars; steering gears made by Gemmer and Chrysler; clutch finger pivots on "Long" clutches for Packard and Lincoln cars and General Motors trucks; and lay shaft applications in the Clark and the Spicer transmissions.

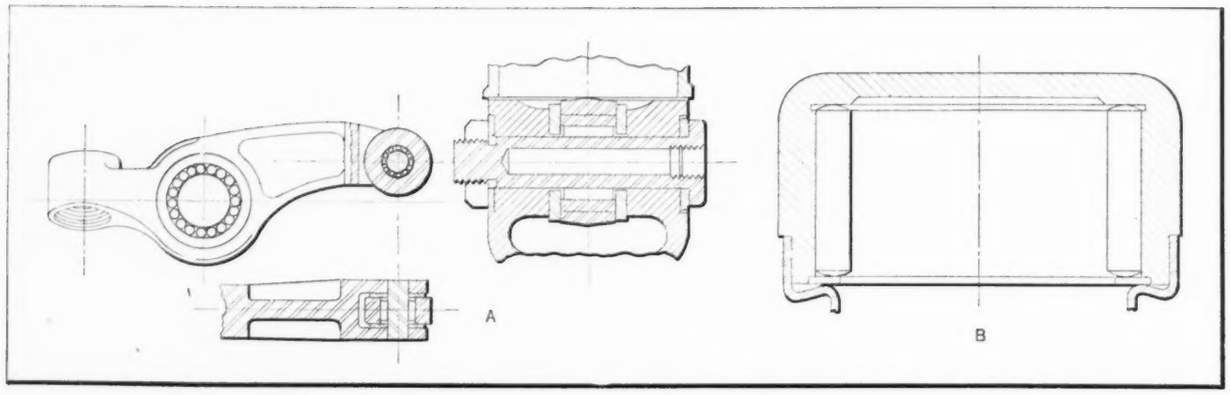


Fig. 2. (A) Application of Quill Bearings to Valve Rocker Arm; (B) Quill Type Roller Bearings in Universal Joint Cup Assembly

Future uses are likely to include over-drives on planetary gears having high rotative speeds and also fan-shaft applications. Experiments have shown that rollers will run in bearing holes in fan-shaft housings of cast iron with very little wear of the latter and no appreciable wear on the fan shaft itself. Preliminary tests indicate that Quill bearings can be used in the larger ends of connecting-rods turning up to 5000 revolutions per minute, although some problems remain to be solved in this application.

Winton is using Quill bearings in the piston-pin mountings of two-cycle Diesel engines for the Union Pacific and for the Burlington streamline trains. Similar applications are reported to be working well in submarine and coastguard boat engines. Quill bearings are being used on heavy-duty pumps of the eccentric-ring type made by the Northern Pump Co. In these pumps, the slipper shoes on the ends of the plungers or pistons are mounted on quill rollers and the main pump body casting rotates over the stationary center valve chamber piloted on similar rollers. This pump operates under a pressure of 4000 pounds per square inch, and the load on the rollers is about 8000 pounds per square inch of the projected area.

Experimental applications on crank-pin and connecting-rod mountings on the four-cylinder locomotive *L. F. Loree* of the Delaware & Hudson Railroad are reported to be successful, whereas brasses in similar locations gave considerable trouble. These are said to be the first practical applications of anti-friction bearings for this purpose on any steam locomotives.

Another form of bearing now being used especially on spring shackles and the "knee-action" joints of the General Motors cars not employing the Dubonnet suspension system, is the threaded type of plain bushing shown in Fig. 1. The great advantage of this type is that it retains lubricant better than most bushings and also tends to exclude dirt and water. Consequently, wear is minimized and play or looseness does not develop so quickly as in an ordinary plain bushing.

Moreover, this bushing has considerable thrust capacity, whereas a plain bushing has none, unless the shaft is flanged or otherwise arranged to bear on the end of the bushing. This form of threaded bushing lends itself to ready production at low cost on automatic machines, and should find non-automotive applications, if it has not already done so.

Porous types of bronze bushings, though not new and perhaps not originally developed for the automotive field, have increased their utility in automotive and other applications by new forms of mountings, some of which hold sufficient oil for the probable life of a machine. Oil or even grease of the proper kind feeds readily through this type of

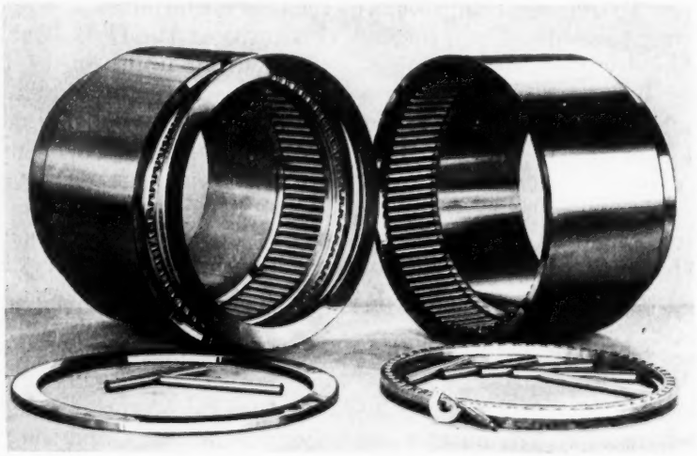


Fig. 3. Bantam Quill Type Bearing for Roll Neck Used in Plate Mill. Outside Diameter of Bearing, 21 1/2 Inches; Length, 12 1/2 Inches

bushing, which acts as a capillary reservoir. The same type of material is used for thrust washers and other parts having bearing surfaces such as those used, for example, in the form of disks set between the leaves of springs and as parts of the dovetails and lock-strikes on closed-body doors. Lubricant absorbed by the porous metal keeps the bearing surfaces lubricated for long periods without adding oil, and the graphite content is said to prevent freezing in any case, even though other lubricant supplies fail.

Thin-Shell, Steel-Backed Bearings

Another form of plain bearing that has gained very wide use in the automotive field in the last few years is the thin-shell type, usually made with a steel back, 1/16 inch or less in thickness, lined with babbitt. Some bearings of the same type, however, have bronze backs, and some are lined with a mechanical mixture of lead and copper, sometimes termed "lead-bronze." The latter is softer than babbitt at ordinary room temperatures, but is considerably harder than babbitt at temperatures of 300 to 400 degrees F., such as may be attained in service in automotive engines of the heavy-duty type. It thus permits of service where a babbitt-lined bearing is likely to fail.

Fig. 4. Several Types of Thin-shell Bearings with Babbitt and Copper-lead Linings

All thin-shell bearings of the previously mentioned types produced by the Cleveland Graphite Bronze Co. are formed from strip stock in coining and stamping operations, the stock having first been coated with a uniform layer of babbitt or lead-bronze. In some cases when steel is used, it is plated with copper to prevent corrosion.

Thin-wall bushings and split bearing shells produced in this way are finally broached to size and are held to extremely close dimensions. In addition, being of uniform section, the babbitt or copper-lead lining is perfectly uniform in character, thus avoiding difficulties encountered with bearings centrifugally cast into shells of non-uniform section, as in the big ends of connecting-rods, for example, where the variation in wall thickness results in heat being conducted away too rapidly at some points to give a uniform coat of babbitt.

It was first thought that such thin-shell bearings lacked the required stiffness and would make it impossible to conduct the heat away rapidly enough. There has been no trouble from this source, however, when the seat provided has adequate stiffness and the shell fits it properly, as it is readily made to do. In consequence, this form of bearing has gained very wide use in connecting-rod and crankshaft main bearings, where its performance has been excellent, and it is used also on camshafts, piston-pins, and in other locations.

Tests of thin-wall main and connecting-rod bearings made recently by the Studebaker Corporation [See a paper, "Recent Developments in Main and Connecting-Rod Bearings," by S. W. Sparrow, read at the recent Summer Meeting of the Society of Automotive Engineers] showed that failure of the babbitt-lined type sometimes occurs as a result of cracking of the babbitt lining. Compared with the copper-lead type having a typical analysis of 45 per cent lead, 2 per cent nickel, and the remainder copper, the latter stood up well in fifty-hour tests at full load and 4500 revolutions per minute, whereas the babbitt type often failed after about thirty hours. The copper-lead type appears to crush as readily as babbitt, but metal-to-metal contact produces a film of lead which presumably has sufficient lubricating value to prevent seizing.

Excessive crankpin wear encountered in early tests with copper-lead bearings was overcome by an increased oil pressure, after which no difference in this respect as between the copper-lead and the babbitt type was noted. Interruption of the oil supply resulting in bearing failure seemed to cause less harm to the crankpin in the case of the copper-lead type. Babbitt bearings replaced after such failure usually have short life, but no trouble was encountered with the copper-lead type after a similar replacement. Experience showed that, in fitting the thin shell to the rod or bearing seat, the outer circumference of the shell should never be less than the circumference of the hole, but should not be enough greater to put unnecessary strain on the bearing bolts or to distort the hole. If the shell circumference is less than that of the hole and a bearing seizes, retaining lugs may be broken, permitting the bearing to turn.

In the case of copper-lead shells, certain oils are unsuitable for lubrication, as they result in chemical attack on the lead, which is washed away rapidly, leaving a porous copper structure and resulting in excessive clearance.

The thin-shell bearing is low in cost and permits use of a housing of smaller diameter, thus saving metal and making for a lighter assembly. It is very inexpensive to replace, should failure occur or wear require its removal. Bearings of this form are employed in Ford, Chevrolet, Chrysler, and other makes of engines and have already found some non-automotive applications in electric motors.

EDITORIAL COMMENT

All factors considered, no industry in the United States has made such progress in the last twenty-five years as the automobile industry. In 1909, the total number of cars and trucks produced was 131,000. Twenty-five years later, in 1934, despite the adverse industrial conditions, this figure exceeded 2,885,000; and the average for the last ten years has been more than 3,500,000 annually, the peak being reached in 1929 when 5,600,000 vehicles were built.

A Great Industry that is Constantly Forging Ahead

The automobile industry has never been content to stand still. It has never rested on the laurels of past achievements. It has constantly pressed ahead, doing new things in new ways. A couple of years ago, it was generally thought that automobiles had well nigh reached mechanical perfection, as well as the final stage in appearance. Little was expected by the general public in the way of outstanding improvements.

Yet, the last year has seen radical advances, not only in appearance but in engineering features. The casual observer may have been most strongly impressed by the streamline body designs, some of which foreshadow an entirely new type of car; but from an engineering point of view, the streamline designs, important as they are, represent but one of many trends. There are the independent springing and knee action, higher compression, superchargers, improved engine controls, new features in frame construction, and far-reaching developments in body-building methods. Even the improvements in car ventilation involve mechanical problems and new production methods that have required engineering ingenuity for their solution.

Wise Expenditures for Shop Equipment Have Greatly Reduced Costs

All this development work has meant not only a great deal of engineering thought, but also large expenditures of money. Few people not directly connected with the automobile industry realize the enormous sums that are spent annually by the automobile companies for equipment and tools. With constantly reduced prices of cars, costs must be reduced; and with competition extremely keen, quality must be improved. These two objectives can be obtained in only one way—by the installation of improved shop equipment. While exact figures are not available, it is estimated that the automotive industry spent approximately $55,000,000 last year on machine tools, metal-cutting tools, and auxiliary shop equipment. One company alone spent $12,000,000; another over $6,000,000 in preparing for the manufacture of a new model; and still another spent close to $5,000,000.

In this work of reducing costs and improving quality, automobile production managers, equipment engineers, and time-study supervisors have worked in close cooperation with the machine tool builders; and it is largely because of such cooperative efforts, that the automotive industry has achieved such remarkable results—results that not even the most far-seeing engineers in either the automobile or machine tool field would have dared to predict fifteen years ago.

And so the automotive industry, this year, has again mobilized for a renewed effort to hasten the nation's recovery. Many of the important improvements to be found in this year's models give evidence of the earnestness with which automobile executives are determined to make progress in spite of present difficulties. It has become almost traditional that the new cars offered each year must represent progressively higher dollar values.

Automotive Industry Has Done Much for National Recovery

It is doubtful if any other single industry has contributed more to the country's economic rehabilitation than the automobile industry. It provides the largest single market for machine tools, small tools, and shop accessories, steel, malleable iron, die-castings, nickel, lead, lubricating oil, rubber, plate-glass, mohair, and upholstery leather; and, in addition, it is a most substantial consumer of copper and aluminum, as well as of many of the metal alloys.

Great credit is due an industry that has had the courage to go ahead in the face of the adverse conditions of the depression. The enterprise and resourcefulness of the automobile industry have been a beacon in the dark years through which industry has passed.

New Equipment for Automotive Shops

Machines of Recent Design, Developed Primarily for Use in the Automotive Field, But Which Can Also Be Applied Advantageously in Other Metal-Working Shops

Ajax Solid-Frame Forging Presses Operated by Air Clutches

High-duty fast-operating presses designed primarily for accurate hot forging work and precise hot or cold coining of forgings and other pieces are being introduced on the market by the Ajax Mfg. Co., Cleveland, Ohio, in a line that includes capacities from 500 to 1800 tons. These presses are controlled by the same type of direct pneumatically operated multiple-disk friction clutch that the company developed for use on horizontal forging machines. (This clutch was illustrated and described in November, 1933, MACHINERY, page 169.) Air pressure is introduced behind a piston carried within the flywheel for applying pressure directly to the friction plates of the clutch. This arrangement gives an instantaneous but cushioned response to tripping, which is accomplished through an auxiliary foot- or hand-operated air valve.

The air consumption is low, and by regulating the air pressure at the clutch considerably below the usual shop-line pressure, the torque capacity of the clutch can be definitely limited to just beyond that required for the operation being performed. This affords an effective safety precaution for both the press and the dies. The air-operated clutch enables the presses to be operated at speeds as high as 50 per cent above ordinary speeds.

Another noteworthy feature of these presses is the use of a frame that is a solid, one-piece steel casting. A steel casting is used for the frame because the strength and reliability of this material has proved satisfactory over a period of thirty

Fig. 1. Air-operated Clutches Enable Ajax Forging Presses to be Operated at Unusually High Speeds

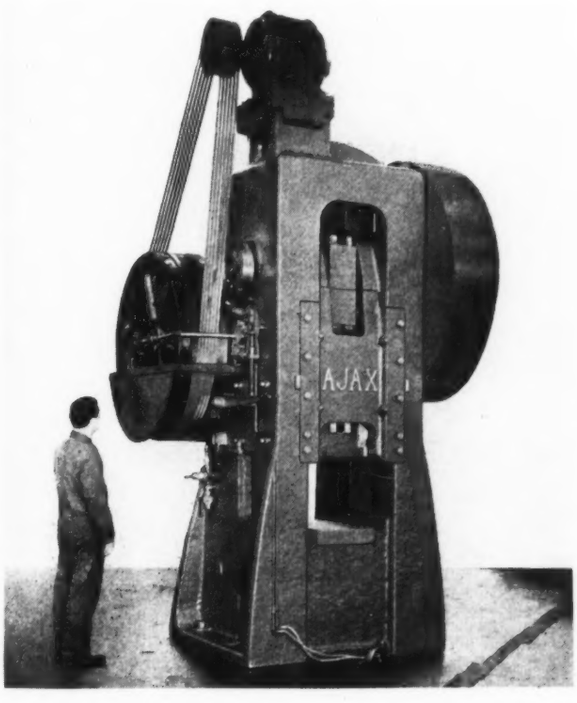


Fig. 2. The Ram of the Press is Made with a Top Extension Bearing that Insures Alignment

years, during which steel castings have been used by the company for the main bed frames of the equipment which it has built.

The main shaft is of the full eccentric type and is a heat-treated forging. It is well supported in the continuous housings of the main frame, which are bridged by a heavy crown rib to prevent deflection and resultant fatigue under extreme pressures. The bearings are of an adjustable split-sleeve type, shims being used at the parting line and a wedge beneath for adjusting to the proper running fit. The main gear which drives the eccentric shaft is of welded steel construction, with the teeth cut in a wear-resisting rim of high-carbon steel. The 1800-ton press is provided with two-stage gearing, the high-speed gears being of the herringbone type and running in a bath of oil.

Accurate alignment of the ram is insured by a top extension bearing at the rear of the frame crown rib, as shown in Fig. 2. With this construction an unusual guide length is obtained without increasing the length of the frame in tension or increasing the length of the pitman and slide in compression. A pneumatic counterbalance for the ram is supplied as standard equipment. The pitman, which is also illustrated in Fig. 2, is cut from rolled steel plate and heat-treated. Its main bearing is accessible for assembly, inspection, and adjustment. To keep down unit pressures to a minimum, the wrist-pin bearing is supplemented by a thrust shoe bearing for its outside surface.

A wedge in the bottom die seat provides for making fine die adjustments without the use of shims. Side wedges and front-to-back poppets facilitate shifting the bottom die in either direction to obtain a proper match with the top impressions. A central knock-out in the ram is mechanically operated, as is also a multiple knock-out in the die seat. The latter has nine stations for ejecting difficult pieces from dies with progressive impressions.

Gleason Spiral-Bevel Pinion Roughing Machine

Both spiral-bevel and hypoid pinions can be rough-machined on the latest development of the line of gear-cutting machines produced by the Gleason Works, 1000 University Ave., Rochester, N. Y. This machine, which is shown in the accompanying illustration, produces from two to three times as fast as the type of equipment formerly built by the company. Of particular importance in the new design is the elimination of complicated mechanical movements, which makes it possible to use a simple automatic lubricating system. All movements are hydraulically actuated, except the drive to the cutter.

Unusual rigidity is another feature of the machine. This has greatly lengthened the life of the roughing cutters, the number of automotive pinions obtained per cutter grind exceeding, in some cases, the number obtained with the older type of machine by 100 per cent. This has been effected even with the higher speeds and feeds at which the new machine is operated. The machine construction enables the pinion teeth to be roughed closer to the finished size, with the result that the finishing machine is required to remove less stock, and this is more uniformly distributed. Not only is there a saving effected in the cost of finishing cutters, but a better finish is obtained.

Many of the functions that were formerly manually controlled are now accomplished automatically from one position on the machine, with the tripping of a few hand-controlled valves. Clamping of the pinion is also effected hydraulically. A built-in device releases the work at the completion of the operation. The average time required for changing the work is only ten seconds.

The cutter is mounted in a full circular cradle which can be adjusted through 360 degrees. The

All Movements of the Gleason Spiral-Bevel Pinion Rougher, Except the Cutter-spindle Drive, are Hydraulically Actuated

work-head swings about an axis other than the center of the machine, so as to provide ample clearance for removing and replacing pinions. The cutter-spindle is driven by a large internal gear and is mounted in anti-friction bearings. A separate motor drives the cutter-spindle.

The circular movements of the cradle and the work-spindle for generating the tooth shape are derived from the reciprocating movements of a pair of racks, actuated by a hydraulically operated roll-piston. Short trains of gearing transmit the motions of these racks to the cradle and to the work-spindle. A hydraulic brake takes up backlash and eliminates the possibility of a change in thrust affecting the quality of the work. The simple generating gear train between the cutter-cradle and the work-spindle takes the place of the crown gear and segment on the older model. Pinions of different ratios can be cut by changing gears in the train to the work-spindle.

The in and out feed of the work-head to permit periodic indexing and the withdrawal movements for unchucking are also effected hydraulically. The feed mechanism operates directly behind the pinion being cut and approximately in line with the point of cutting, so that a smooth and steady feed is obtained. The machine is so arranged that the work-head is withdrawn automatically at full speed when the last tooth has been cut.

Two motors with two controllers, a relay switch, a "plugger" switch for stopping the cutter motor from coasting, and a limit switch comprise the electrical equipment. The machine is interlocked so that the feed will not start unless the cutter is running and the work is chucked. Likewise, the work cannot be unchucked or the cutter stopped while the work is in the cutting position. The machine is designed to accommodate cutters 6, 9, and 12 inches in diameter, which run at speeds of from 72 to 180 feet a minute.

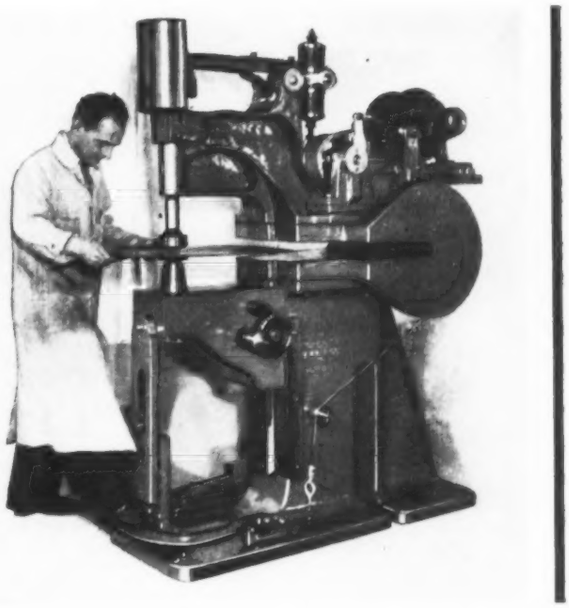
High-Speed Hammer for Automobile Body Work

Trimmed butt welds on sheets of No. 20 gage steel used in the manufacture of automobile bodies are being flattened at the rate of 70 inches a minute in one plant by the use of special machines recently built by the High Speed Hammer Co., Inc., 305-321 Norton St., Rochester, N. Y. On these sheets the riser, which has been trimmed, averages about 0.004 inch per side. The hammering operation quickly reduces this thickness to the gage of the metal. The production time, of course, depends on the amount of material left for flattening after the trimming operation and on the gage of the sheet. The hardness of the sheet and of the weld also materially affects the production time.

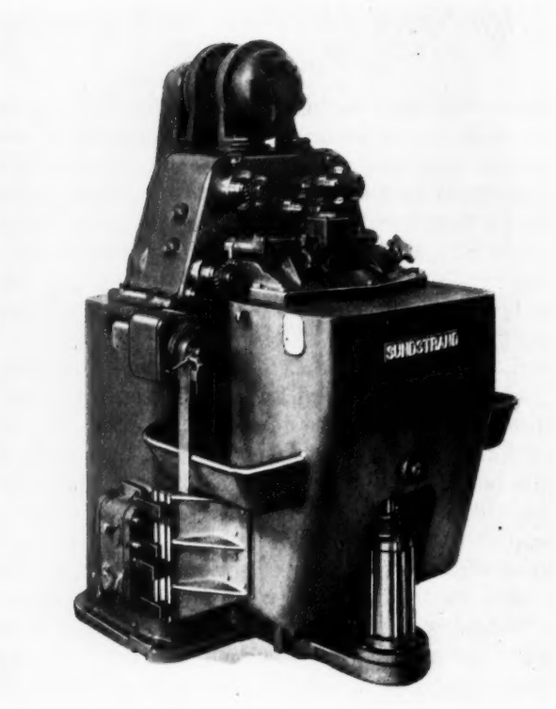
In the method of manufacture previously followed in this plant, two stampings were cut out and welded together after the forming operations. A portable tool was then employed for removing the excess welded material, and there was always danger of marking the sheet or removing more metal than was desirable. Grinding to clean up the welds also had the same drawbacks.

With the method at present employed, two flat sheets are butt-welded together, and the flash is then removed by a standard flash trimming machine, after which the sheet is given a uniform thickness throughout by one of the high-speed hammering machines. The welded sheets are now stamped and formed without any danger of the weld opening or fracturing. The sheets are then ready for finishing, priming, and painting, without the need of soldering, filling, filing, or similar preliminary operations.

These hammers have a gap of 35 inches. The handling of the large welded sheets is facilitated through the use of roller tables or ball transfers constructed on each side of the machines.



High-speed Hammer Designed for Flattening the Butt Welds on Sheet Steel Used in Making Automobile Bodies



Automobile Manifolds are Milled by Rise-and-fall Movements of the Vertical Sundstrand Rigidmil

Sundstrand Rise-and-Fall Rigidmil

Hydraulic feeding has been advantageously employed by the Sundstrand Machine Tool Co., 2530 Eleventh St., Rockford, Ill., in a rise-and-fall Rigidmil recently designed for finishing eight surfaces on intake manifold flanges. The castings are so shaped that the cutters cannot pass entirely across them, a condition that would ordinarily make the operation slow and expensive. Because of this condition, the machine was so designed that the work is first fed upward to three cutters and then downward to five additional cutters.

The operating cycle is automatic after the machine has been started. It includes a rapid approach to the three upper cutters, a feed for milling the three upper surfaces, a reversal at the end of this cut, a rapid approach to the five lower cutters, a second feeding movement, a reversal at the end of this cut, a rapid return to the loading position, and stopping. These table movements are controlled by adjustable dogs at the left of the operator. They are actuated through the hydraulic cylinder at the lower front of the machine.

There are two separate motors for the hydraulic power unit and for the multiple-spindle head that carries the milling cutters. The column of the machine is constructed of welded steel, whereas the member at the front of the machine which carries the table is a heavy casting. Two of these machines can be run by one operator.

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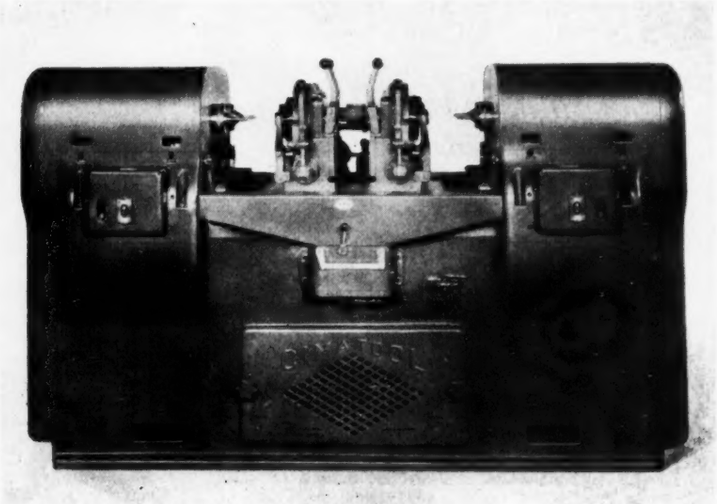
Cimatool Precision Boring Machines

Heavy-duty precision boring machines of double-end construction, as illustrated, are now being introduced on the general market by the Cimatool Co., E. Third and June Sts., Dayton, Ohio, after a satisfactory performance in production plants for a period of over two years. This model weighs 5 1/2 tons and is designed to provide maximum resistance to distortion and vibration. The table operates on vee and flat ways of large area which are lubricated by oil overflowing from a pump-fed constant-level reservoir. Coolant is supplied by the customary methods. Provision has been made to insure that chips cannot interfere with the table movements.

The boring head provided on this machine is dynamically balanced and is housed in a rigid casting. The spindle is mounted in two sets of selected precision ball bearings which are preloaded by

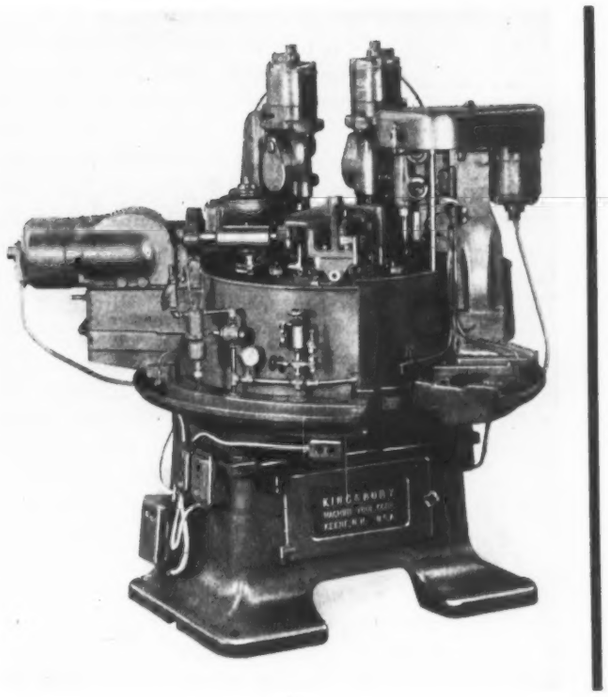


Heavy-duty Precision Boring Machine of Double-end Construction Placed on the Market by the Cimatool Co.

Automobile-door Handles are Milled, Drilled, and Countersunk by this Kingsbury Machine

automatic spring take-up devices. The pressure on both bearings is equalized to eliminate lost motion or end play and to neutralize the effects of wear. A composition ball cage aids in providing thorough lubrication and reduces the effect of operating temperatures on the action of the bearings. The head construction is such as to insure constant spindle lubrication. The boring heads are available in a number of standard and special sizes to meet various requirements.

The Cimatool Co. also builds a universal model precision boring machine which has only one bank of spindles and is therefore of less capacity than the heavy-duty machine. However, the cycle control, boring head, and rigid construction are the same in both models.



Kingsbury Milling, Drilling, and Countersinking Machine

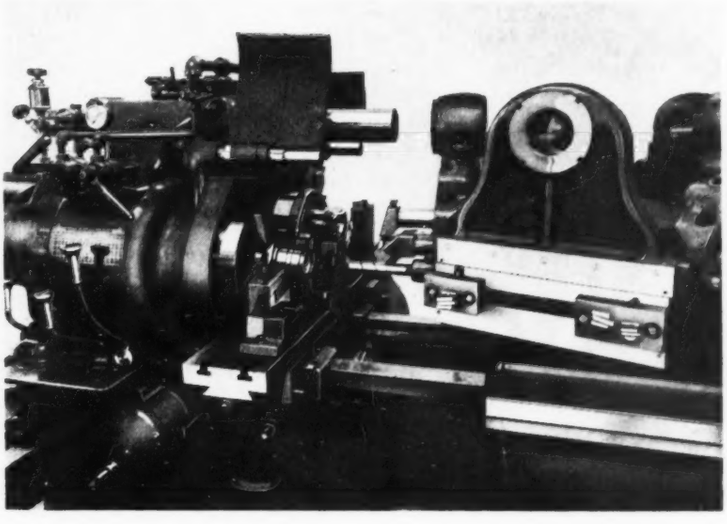
A machine recently built by the Kingsbury Machine Tool Corporation, Keene, N. H., straddle-mills the end of automobile-door handles, drills a 3/16-inch hole crosswise through the handle in two steps, and countersinks both ends of the cross-hole. The milling unit is a new development. It is equipped with a spindle that revolves in Timken roller bearings. A flywheel is mounted on the spindle at the upper end.

Guide bars for the milling unit are attached to a bracket that is mounted on the center portion of the indexing fixture, a construction that affords the necessary rigidity. The machine operates at a production rate of 950 pieces an hour.

Power-Flex Automatic Chucking and Turning Machine

Maximum flexibility and high productive capacity are features of a Power-Flex 5-D two-spindle automatic chucking and turning machine recently developed by the Potter & Johnston Machine Co., Pawtucket, R. I. The base of this machine is provided with hardened steel ways which are ground in place after assembly. The advantages derived from this construction are permanency of alignment, freedom from scoring, and long life.

Helical gears of chrome-nickel steel are provided in the headstock. The spindles and all shafts run in anti-friction bearings. Twenty-eight speeds ranging from 19 to 613 revolutions per minute are available in seven sets of four automatic changes each. Any group of automatic changes can be



Potter & Johnston Automatic Chucking and Turning Machine Designed for Flexibility and High Production

quickly obtained by using the proper set of pick-off gears in a compartment of the headstock. An automatic spindle stop makes it possible for the tools to be returned to their neutral positions without scoring the work.

Twenty-four feeds are available. Either a coarse-feed box with a range from 0.0057 to 0.125 inch per spindle revolution can be provided or a fine-feed box with a range from 0.0057 to 0.062 inch. Coarse, medium, and fine automatic feed changes can be selected. The fast motion is obtained directly from the main driving pulley, and is therefore constant.

The cross-slide cam-drum is located directly under the cross-slide. Ball-bearing cam-roll studs mounted on the cross-slide furnish a direct connection. The cross-slide mechanism is fully enclosed and runs in oil. The turret slide is provided with hardened and ground inserts that bear on the steel ways of the base.

Power-operated automatic clutches under dog or hand control are provided on this machine. All speed and feed changes can be made while the machine is in operation. Air or electrically operated chucks can be provided. The center-to-center distance between the two spindles of this machine is 15 1/2 inches, while the swing over the cross-slide is 13 1/8 inches. A constant-speed motor at the rear of the headstock drives the machine through multiple V-belts. The machine has a net weight of 14,000 pounds.

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Electric Quick Return for Porter-Cable Carbo-Lathe

Carbo-Lathes, built by the Porter-Cable Machine Co., Syracuse, N. Y., can now be equipped with a motor-driven attachment which will quickly advance and return the carriage, as well as the facing attachment, if one is provided. This electric quick return is designed to save time and fatigue of the operator on work requiring over 2 inches of carriage travel.

The attachment is fastened to the end of the lathe bed by means of four cap-screws and two dowels, as shown in the illustration. Connection is made to the feed-shaft that runs through the center of the lathe bed by means of a flexible coupling. The attachment is driven by a 1/3-horsepower motor with a special torque winding that is capable of a 300 per cent overload.

The motor and jack-shaft are ball-bearing equipped, and the motor is totally enclosed. It is geared to the jack-shaft with a ratio of approximately 2 1/2 to 1. In this gear drive is a spring-loaded disk clutch which can be set so that it will just drive the carriage, but will slip to protect the motor and feed mechanism if the power feed to the table is engaged and the motor started.

A drum type, reversing, manually operated switch with a "spring neutral" is provided as regular equipment, but an automatic switch can be furnished if desired. Carbo-Lathes are adapted to the machining of a large variety of automobile parts, including steering knuckles, wheel hubs, king pins, stem pinions, brake-shoes, timing gears, pistons, valves, transmission gears and shafts, brake-drums, and universal drive parts.

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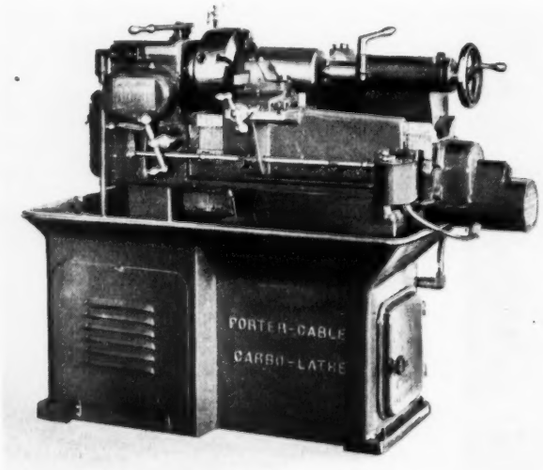
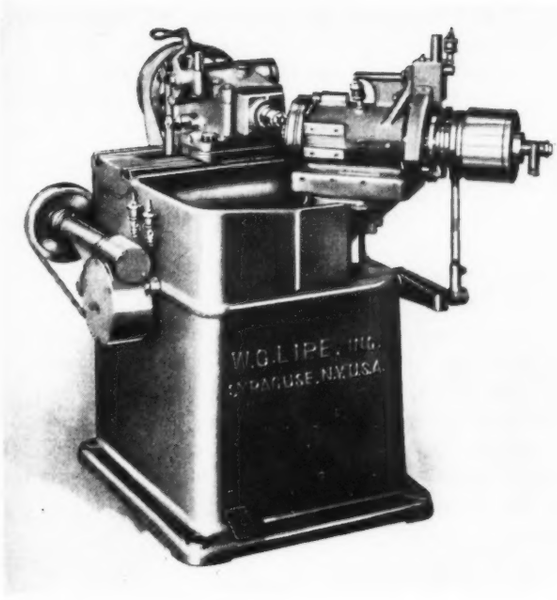
Lipe Single-Spindle Gear-Tooth Chamfering Machine

Gear teeth up to 150 a minute can be chamfered on a single-spindle, high-speed machine being placed on the market by W. C. Lipe, Inc., Syracuse, N. Y. This machine operates on the same basic principle as other chamfering machines built by the concern over a period of years. However, it is much heavier than previous models to suit the higher speeds of operation.

The gear to be chamfered is mounted on the work-head, either an air-actuated collet or a draw-



A Motor-driven Attachment can now be Applied to the Porter-Cable Carbo-Lathe for Quick Operation of the Carriage



Gear Teeth are Chamfered at Speeds up to 150 a Minute on this Single-spindle Lipe Machine

rod and U-washer being used. The gear is automatically indexed to the successive chamfering positions and positively held during the cut. The cutter is automatically fed into the work, and it usually straddles two teeth. As each cut is completed, the cutter is withdrawn and the gear indexed to the next position. Long cutter life is obtained by using special internal formed hollow-mills developed by the concern primarily for chamfering.

Other features of the machine construction include a ball-bearing cutter-spindle with an inserted steel rack and increased bearing area; a ball-bearing worm drive; and a large-diameter index-shaft and camshaft to which assembled parts are splined. Spur, helical, and spiral-bevel gears, including internal and external gears, can be chamfered on this machine. The machine will also chamfer splines, remove burrs from helical or spur gear teeth, and perform drilling and milling operations. It supplements the double-spindle model described in June, 1934, MACHINERY, page 628.

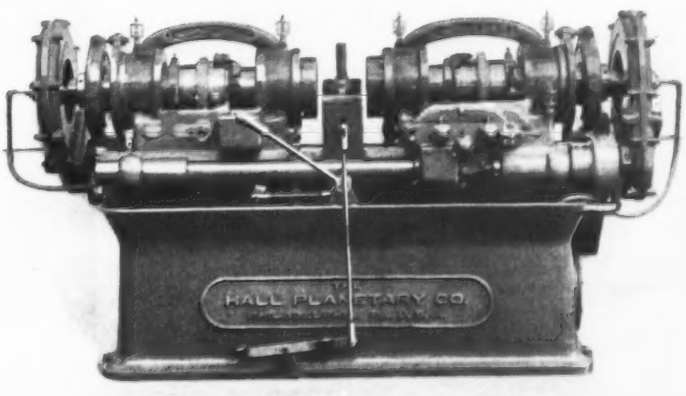
Hall Double-Head Planetary Machine

There are a considerable number of automotive parts that must be either threaded or milled in an annular manner at both ends. The list includes such parts as rear axle housings, exhaust manifolds, radius rods, universal joints, anti-friction bearings, and airplane-propeller hubs. For performing such milling and threading operations simultaneously at both ends of the work, the Hall Planetary Co., Fox St. and Abbotsford Ave., Philadelphia, Pa., has brought out the double-head machine here illustrated.

Like similar single-head machines built by the concern, the new model performs Planathreading when equipped with master threads for advancing the spindle, and Planamilling when equipped for that operation. Internal Planamilling consists of finishing holes of one or more steps, while external Planamilling consists of machining annular grooves which may extend completely or part way around a circle.

Two cutter-head assemblies are rigidly mounted on the bed of the new machine. Both assemblies are moved toward the center of the machine to bring the cutters into the working position by moving a hand-lever at the left of the operator. This movement is imparted to the two assemblies through a toggle and bellcranks. With this arrangement, the entire assemblies are moved rather than the cutter-spindles alone, and cutter overhang is reduced to a minimum. The movement of the spindles is positively effected because of the toggle action. The relative position of each spindle is determined by means of a separate adjustment.

The machine illustrated is set up for cutting two annular grooves in opposite ends of the king-pin



Opposite Ends of Parts Can be Simultaneously Planamilled or Planathreaded by the Hall Double-head Machine

hole in an automobile front axle. The axle is held on the central stationary fixture by two plugs which are moved outward and into the interrupted king-pin hole when the foot-pedal is depressed. This leaves the outer ends of the king-pin hole free so that the cutters can enter.

After the work has been positioned, the operator moves the lever at his left. This simultaneously advances the cutter-spindles, as already explained, starts them on their cutting cycle and turns on the cutting compound. The cycle is then carried through automatically. The floor-to-floor time for Planamilling the two annular grooves simultaneously is 30 seconds. When one end of the axle has been machined, the axle is turned end for end for repeating the operation on the opposite end.

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Hydroptic Precision Boring and Milling Machine

Milling to close tolerances, as well as accurate boring, can be performed on a Hydroptic machine of the jig boring type recently developed by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland. The milling feature represents a radical departure over previous models, designed for precision boring only.

The fact that both milling and boring can be performed at one setting of the work considerably widens the scope of the machine, so that it can be advantageously used in direct production and for experimental work, as well as in making jigs and fixtures. Fig. 2 shows a milling operation being performed on a typical box jig after a series of holes have been accurately bored by the same machine. The Triplex Machine Tool Corporation, 125 Barclay St., New York City, is the agent for this machine in the United States and Canada.

Another important change in the machine is that hydraulic power has been adopted for traversing the table. Speeds from 0.2 to 80 inches a minute are instantly available for quickly positioning the table or for use in milling operations. The speed of the table traverse depends upon the amount of movement imparted to the hydraulic control lever seen at the extreme right in Fig. 3. This lever can be maintained in any position by merely adjusting a button.

The hydraulic table traverse saves a great deal of time on most jobs. A hand motion is used in combination with a microscope in making final table settings, as will later be described. When a setting has been made, the table is locked to the bed by simply operating a lever. The movement of this lever automatically releases the oil pressure in the hydraulic system. Both the power and hand table adjustments are then inoperative.

Another improvement embodied in the new machine is a power feed for the spindle head along the cross-rail at the rate of 2.4 inches a minute derived

Fig. 1. Accurate Milling and Boring can Both be Performed on this Societe Genevoise Machine

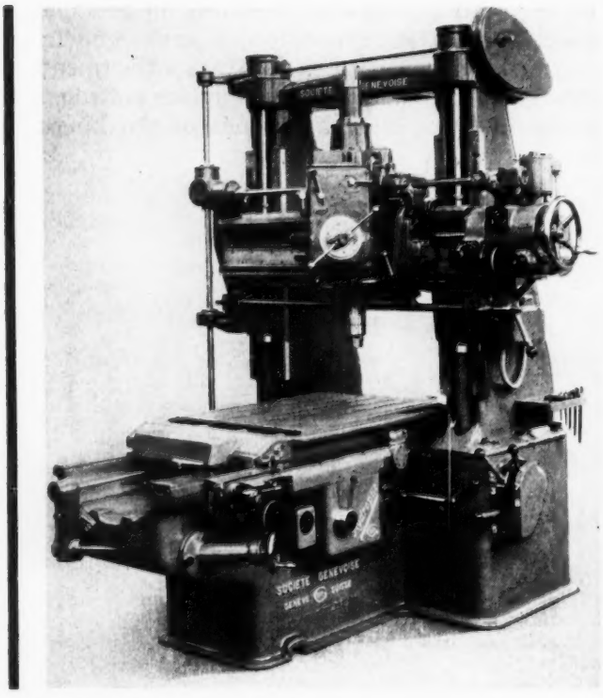
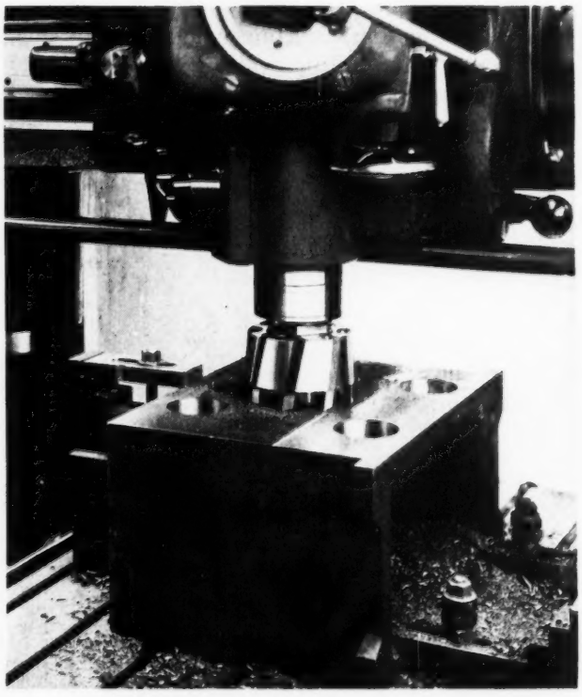


Fig. 2. Milling a Box Jig after Holes have been Bored within Close Tolerances



from a vertical motor on the cross-rail. Fast and slow hand feeds are also provided, and use can be made of the hand feeds without disengaging the power feed. The cross-rail is adjustable vertically by power. Six rates of spindle feed are available in both directions, the feeds ranging from 0.0016 to 0.01 inch. There are eighteen spindle speeds, from 40 to 1250 revolutions per minute, which adapts the machine to the use of tungsten-carbide boring tools.

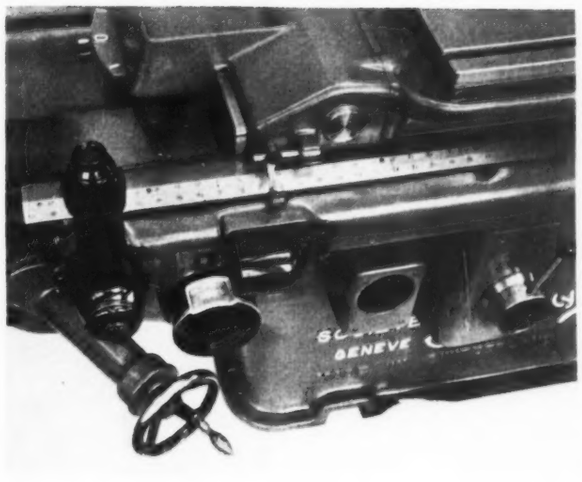


Fig. 3. The Devices Used in Accurately Setting the Table and the Hydraulic Control Lever

Optical means are furnished on this machine to insure accurate settings of the table and the spindle head, microscopes being built into the bed and the cross-rail for observing graduations on precision scales attached to the table and the spindle head, respectively. These scales are sealed from dirt or other foreign matter in order to preserve their accuracy. The eye-piece of the microscope used in setting the table is seen at the left in Fig. 3. When not in use, it is swung down into the horizontal position. The scale seen in the same illustration is used in approximating table settings, the final reading being made through the microscope and the adjacent micrometer drum.

In practice, the table is positioned approximately by means of the hydraulic traverse. Then the hydraulic control lever at the right in Fig. 3 is released and the final positioning of the table is made by turning the handwheel at the left. The microscope used in determining settings of the spindle head is contained in the unit at the right-hand end of the cross-rail.

The working surface of the table is 39 1/2 by 27 3/4 inches. The table has a longitudinal travel of 37 inches, the spindle saddle a transverse movement of 24 inches, and the cross-rail a vertical adjustment of 20 inches. The minimum distance from the boring head to the table is 8 inches.

▼ ▼ ▼

Norton Semi-Automatic Six-Inch Type C Grinder

The latest machine built by the Norton Co., Worcester, Mass., primarily for the automotive industry is a 6-inch Type C semi-automatic grinder. The spindle of this machine is flood-lubricated and is end-driven through multiple V-belts by a motor mounted directly on the wheel unit, this being standard practice on all cylindrical grinding machines built by the concern. No idlers or intermediate shafts are used, the only major revolving elements being the motor armature and the grinding-wheel spindle.

Flexibility is one of the advantages of the entire 6-inch Type C line. For example, the hydraulic traverse machine illustrated and described in November, 1934, MACHINERY, page 185, can be converted at any time into the semi-automatic machine or vice versa. This feature minimizes obsolescence, since a machine bought now for work requiring the hydraulic traverse can be changed over in the future, if desired, to perform semi-automatic operations. A machine can also be arranged to perform both hydraulic-traverse and semi-automatic operations, either when purchased or after it has been installed.

With the semi-automatic arrangement, one lever controls all the functions necessary for grinding a single piece. The operator simply loads the machine, moves this lever, and then proceeds with the performance of other duties, such as changing dogs or loading another machine. When the piece has been ground to the diameter for which the machine is set, the wheel unit moves rapidly to its rearmost position and the work automatically stops rotating. The machine then remains inoperative until reloaded and again started by the attendant.

Both the table and wheel-slide ways of the semi-automatic model are force-feed lubricated, as on all cylindrical grinders of the company, the oil being pumped at a definite pressure to the center of the ways. It passes between the stationary and moving members to the ends of the ways and then back to the reservoir.

Two standard machines are built for work up to 18 and 30 inches between centers. The net weights are about 4000 and 4500 pounds. The standard grinding wheel is 20 by 3 by 12 inches, and the hole size is the same as on the wheels of the larger machines. This permits the user of a large battery of grinding machines of various sizes to transfer wheels from the larger machines to the six-inch semi-automatic when the wheel diameter has been reduced to 20 inches.

Welding Mufflers in 14½ Seconds

Unusually high production rates in the welding of automobile mufflers are being obtained in one large plant through the recent installation of seven Electronic Tornado automatic arc welders built by the Lincoln Electric Co., Cleveland, Ohio. These machines produce 250 complete mufflers an hour.

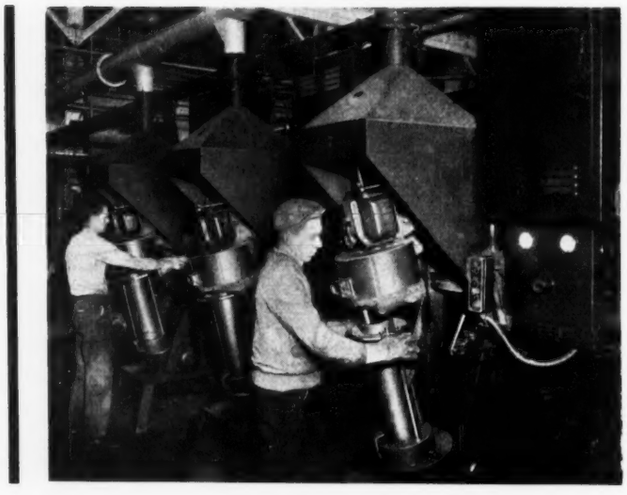
The first operation, which is performed by three machines arranged as shown in Fig. 1, consists of welding three louvered tubes to the inner shell. The three tubes are welded in place in approximately 7 1/2 seconds. The second operation, which is shown in Fig. 2, consists of welding the muffler heads to the inlet and outlet tubes. Two men operating four machines do this welding at the rate of one muffler every 7 seconds.

High-speed welding is possible in these operations because, with the Electronic Tornado method, the carbon arc is controlled by superimposing a strong magnetic field on the arc. This results in puddling and refining the molten metal during the welding. All the heat of the arc is concentrated over a very small area of the material being welded.

The welding head of each machine contains the carbon electrode, a mechanism for feeding the fibrous autogenizer, and the filler metal. The autogenizer shields the molten metal and prevents the inclusion of oxides and nitrides in the weld.

In the automotive field, the Electronic Tornado system of welding is also being applied in the fabrication of axle housings, torque tubes, brake cross-shafts and wire-wheel hubs. Each application requires, in addition to the welding head, an arc-welding generator and a fixture for adapting the welding head to the particular job. The high speeds obtainable so reduce welding costs that the equipment usually pays for itself within a few months.

Fig. 1. Electronic Tornado Automatic Arc Welders Being Employed for Welding Louvered Tubes to the Inner Shell of Automobile Mufflers



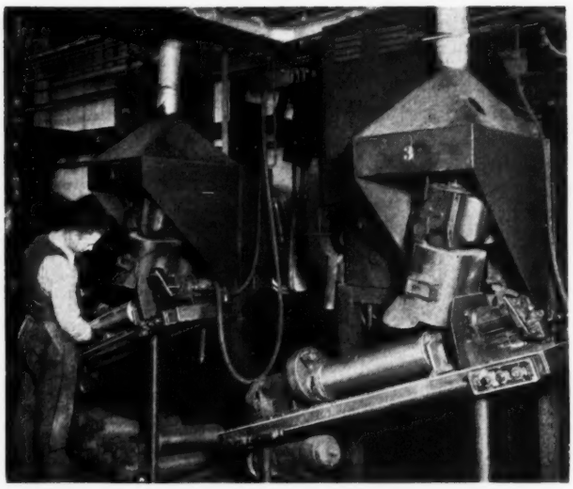


Fig. 2. Welding the Heads of Automobile Mufflers to the Inlet and Outlet Tubes by Employing High-speed Automatic Machines

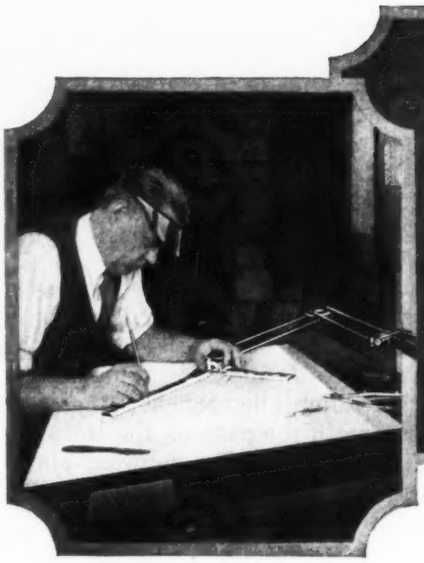
▼ ▼ ▼

Developments in Resistance Welding in the Automobile Industry

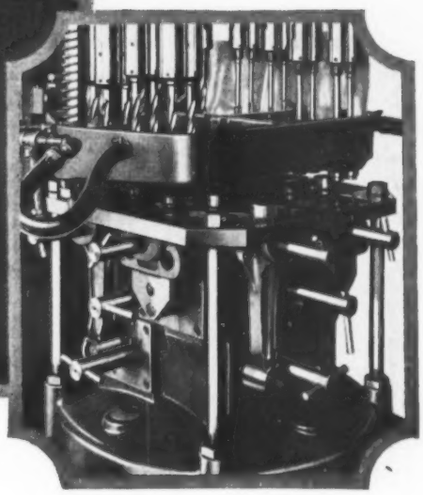
At the recent annual meeting of the Society of Automotive Engineers, P. W. Fassler, president of P. W. Fassler & Co., and a consulting welding engineer, called attention to the rapid strides of resistance welding applications in the automotive industry during recent years. He stressed the point that the automobile industry deserves more credit than any other branch of mechanical activity for the rapid development of electric resistance welding in the last ten years.

A decade ago resistance welding was certainly in its infancy. Butt-, flash-, seam- and spot-welding machines were built, but generally for small production. Today, to suit the high-production requirements of the automobile industry, the equipment using these welding methods has been highly improved and new welding methods have been added.

The author stated that over 50 miles of straight seam welding is produced on flash welders every day in automobile plants. Rear-axle welders make it possible to weld up to 200 rear axles an hour. Special rim welders produce up to 600 rims an hour. Projection welders, of which there are thousands in production in the automobile industry, weld from two to fifty spots simultaneously.



Design of Tools and Fixtures



Grooving Bar for Cutting Snap-Ring Recess

By CHARLES J. RAYMAN, Tool Designer
Cherry-Burrell Corporation, Cedar Rapids, Iowa

The ball bearings assembled in the cast-iron frame of a certain machine are held in place by snap-rings that fit into grooves such as shown at *A* and *B*, Fig. 1. The grooving bar shown in Fig. 2 was designed for cutting these grooves on a horizontal boring machine, following the boring operation. The bar is inserted in the spindle of the boring mill. It is then fed in until sleeve *D* makes contact with the face of the hub. As additional pressure is applied from the spindle-feed handwheel, shank *A* is forced into pilot *G*. The portion marked *L* on shank *A* is a cam, the slope of which is equal to the depth of cut required for grooving. This cam forces the tool-retaining block *H* outward and into the cutting position.

Screw *F*, which is locked in place by a set-screw *E*, follows the lower taper as the spindle feed is reversed, causing the tool-retaining block to return to its normal non-cutting position and allowing the bar to be removed from the bore. Pin *C* not only acts as a stop for the inward feed, but also serves as a driver and keeps the parts intact. Spring *B* exerts a pressure of 20 pounds, holding pilot *G* snugly against pin *C*. This insures proper contact of the sleeve *D* with the hub of the work.

It will be noted from Fig. 1 that the grooves are spaced 2.953 inches apart. As sleeve *D*, Fig. 2, is made 2.953 inches long, or equal in length to the distance between the grooves, it is only necessary to remove the sleeve in order to cut the second groove. In this case the flange *K* of pilot *G* makes contact with the bearing hub.

The principal advantages of a bar of this type are that no anchor bar is required to actuate the feed of the tool, nor is it necessary for the operator to count the spindle revolutions to determine the depth of cut, as is common with some tools of this kind. The operator simply removes the boring-bar,

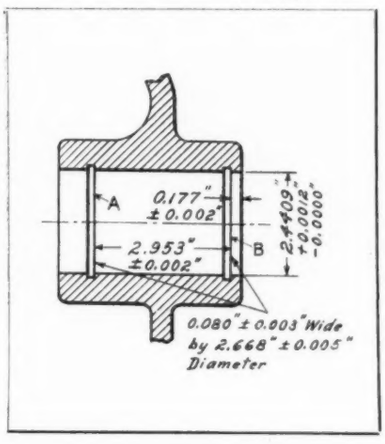


Fig. 1. Ball-bearing Housing or Hub with Grooves for Snap-rings

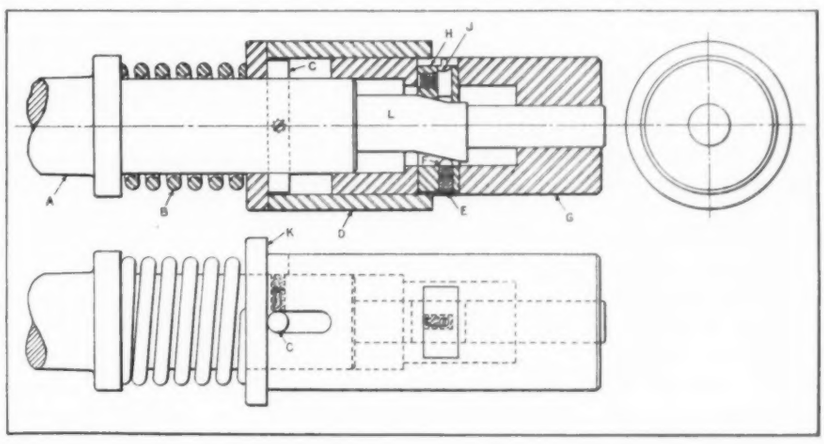


Fig. 2. Grooving Bar Used in Boring Machine for Cutting Snap-ring Grooves A and B in Hub Shown in Fig. 1

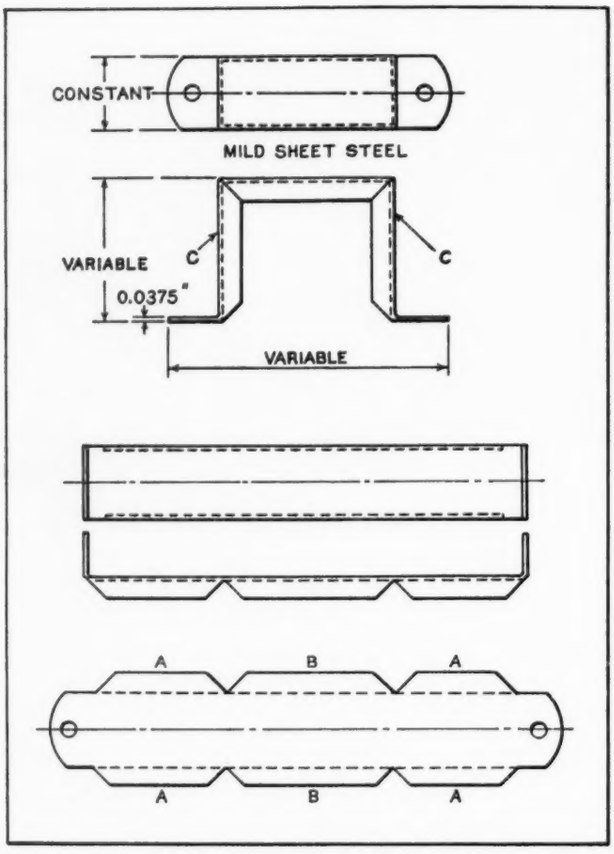


Fig. 1. (Upper Views) One of Four Sizes of Transformer Coil Frames Produced by Die Shown in Fig. 2. (Lower Views) Blanked and Partly Formed Parts

inserts the grooving bar, makes an inward hand feed, and reverses the operation to produce a groove of the proper width and diameter.

Four Cutting and Three Forming Operations in One Press Stroke

By C. W. HINMAN, Atlanta, Ga.

A single-operation progressive die that trims, perforates, shears, performs a first- and second-forming operation, cuts off, and then performs a third forming operation on four sizes of transformer coil frames of the design shown in the upper views of Fig. 1 is illustrated in Fig. 2. The transformer frames are made from mild steel, 0.0375 inch thick, and are used in radio assemblies for covering and mounting transformer coils. The trimmed blank is shown in the lower view, Fig. 1. The same blank as it appears after the first and second forming operations is shown in the central view, while the two views at the top show the blank after the third forming operation, which finish-forms the frame ready for use.

Four lengths and heights of frames are made by the tool or progressive die shown in Fig. 2. This is accomplished by changing the shearing punches *D* and *E*, each of which is made in rights and lefts, and by adjusting the positions of parts *F*, *G*, *H*, and *I* in their respective dovetailed slots, and clamping them by screws in *S* and *J*, after inserting plugs in the locating holes. The other members at *K*, *L*, *M*, *N*, *O*, and *P* are also changed or adjusted to suit the size of frame.

To avoid confusion of lines, only the principal working members are shown. The spring pads *N* and *Q* are prevented from being tilted when the angular shearing punches *D* and *E* come in contact with them, by providing idle punches that are brought into contact with the pads on the sides opposite the shearing punches. The stripper plates are not shown in the plan view.

The work material is sheared in widths that allow 1/4 inch of scrap on each side of the trimming dies. The two trimming punches *H* and *I* have the usual backing-up heels, which, in dies of this character, prevent the punches from shearing or nicking the die edges when cutting into the strip. The two 1/4-inch scrap strips and the small perforated slugs are the only waste, and these are pushed through the dies, leaving no loose pieces or strip on the surface, which might interfere with the punches.

While this tool may appear complicated or impractical, it is operated continuously with no more trouble than other tools or dies of more simple design. When the tool is in use, the strip is entered from the right, under the open-side stripper plates *T* and moved to the left until its forward end comes in contact with the first finger stop (not shown), conveniently placed for locating the stock for piercing the square holes in the bushings at *U*.

Next the strip is advanced against the second stop and the outer ends are trimmed and perforated, after which the forward end is split from the outer diagonal corners of the two square holes through to the outside edges by two punches *D*, acting against the die *F*. Spring pad *Q* is thus depressed, but elevates the work flush with the surface of the dies when the punches ascend. Two pilot-pins *V* locate the strip by entering the perforated holes at the ends of the work.

At the next station, the first and second forming operations take place. In these operations, the four wings *A*, Fig. 1, are bent up by punch *K* when it enters the forming die *M* against spring pad *L*, and the two perforated ears at the ends of the blank are bent down. When the pad comes in contact with the bottom of the die, the first two forming operations are completed. Upon the ascent of the punches, the spring pads again elevate the work flush with the surface of the dies.

The next station is idle, except that the work is guided through it toward the final operation by the length of the spring pad *N*, which is fitted for an easy sliding fit between the two previously formed ears. When the punches ascend, three

spring pads act to elevate the work flush with the surface of the dies.

In the final operation, the forward end of the work registers against the positive stop *W*. The work is now located over the opening in the forming die *P*. Inside this die is a strong spring pad *O*, which holds the face of the work flat while forming and subsequently causes the work to follow the forming punch *X*.

When the punches again descend upon the work, the piece to be formed is severed from the strip by punch *E*, which is a trifle longer than forming punch *X*. The forming punch is already in contact with the blank and holds it positively by its continued descent against the spring pad. This results in pushing the severed work down into the forming die and bending up the two wings shown at *B* in the lower view of Fig. 1 and the frame sides *C* shown in the upper view.

In the next ascent of the press ram, the work, now completed, follows the punch, as previously stated, and is carried into contact with two positive hooks *Y*, which strip it off the punch. The work is done in a No. 4 inclined press, and after the last

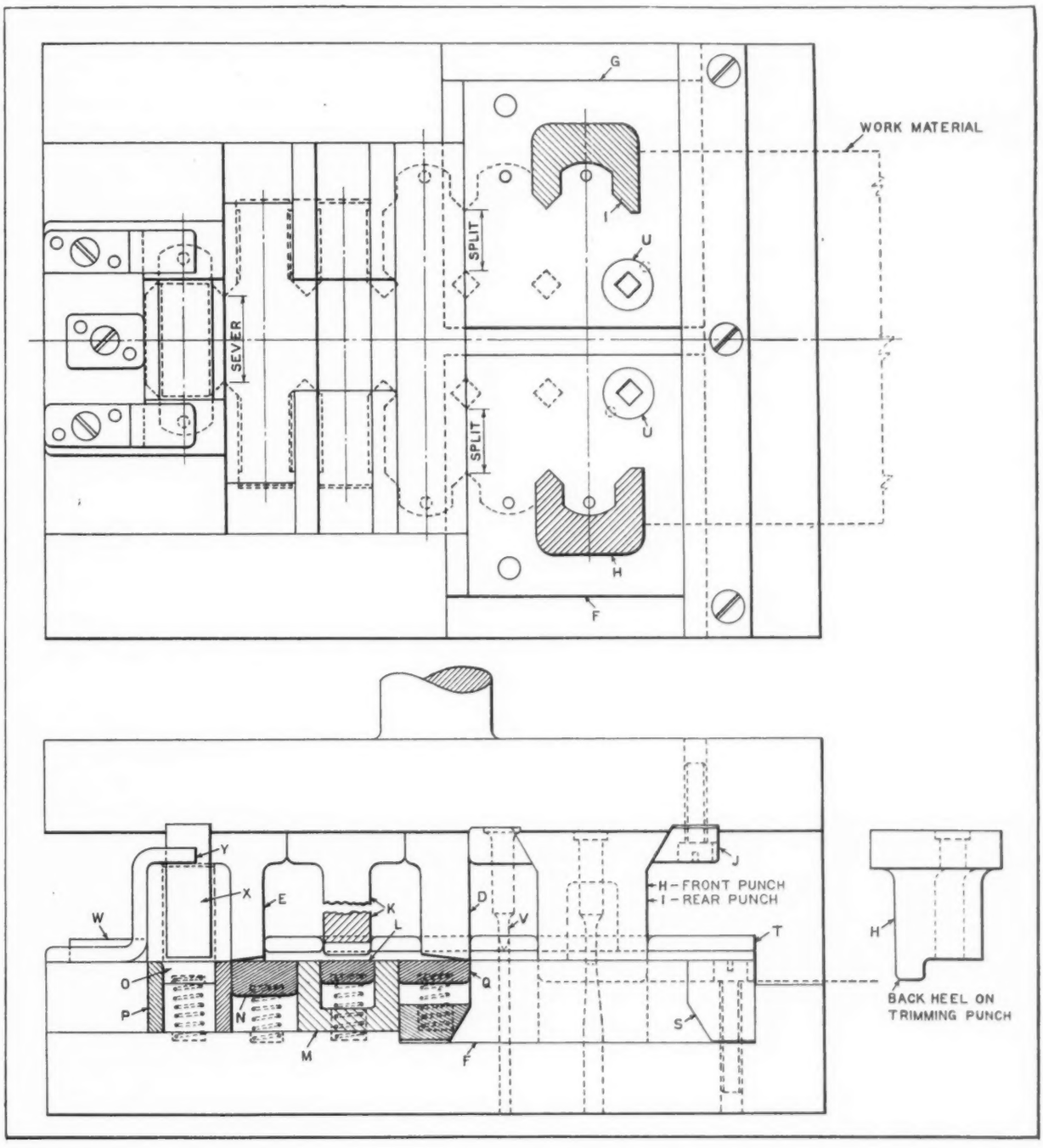


Fig. 2. Progressive Die that can be Adjusted to Produce Four Different Sizes of Frames of the Type Shown in the Upper Views, Fig. 1

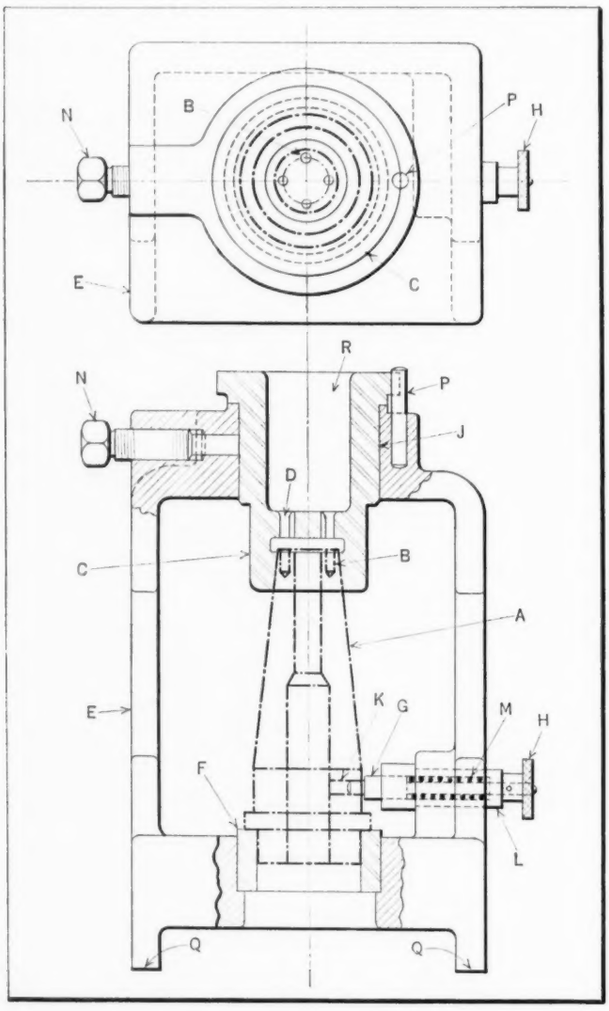
forming punch is withdrawn, the completed parts are free to slide from the die into a container behind the press. All the spring pads are now flush with the die surfaces and the tool is ready to finish the pieces rapidly. The press runs at a speed of 80 strokes per minute, the hourly output being about 3000 pieces. The press is foot-tripped for each piece.

Drill Jig with Tapered Locating Bushing

By FRANK SERRAL

An unusual type of jig in which the work must be located vertically from the cylindrical portion and radially from a hole while four small holes are drilled in the end is shown in the accompanying illustration. In this set-up, the work, indicated at *A*, has the general appearance of a sleeve, the long end of which is tapered.

Bushing *C* has four holes through the surface *D*, which guide the extension drills used in drilling the four holes *B* in the work. The bushing *C* slips over the tapered end of the work and supports it in an upright position. The frame of the jig is shown at *E*. It is made of cast iron, is open at the front, and has side and rear retaining walls. In the lower portion of the framework is mounted a bushing *F* which centers the lower end of the work. There is also a spring pin at *G*, which is pulled back by the knob *H* while putting the work in place. The bushing *C* is also raised to permit loading the jig.



Jig Designed for Use in Drilling Four Holes B in the Correct Position with Respect to Hole K in Part A

The object of spring pin *G* is to locate the work in the proper radial position relative to hole *K* in the work. The spring pin is held in a bushing *L*. The action of pulling back knob *H* compresses spring *M*. The small end of the spring pin snaps into the hole *K* in the work as it is turned radially while resting in bushing *F*. With screw *N* released, the bushing *C* is slid down over the upper end of the work until the tapered hole in the bushing is tight on the taper of the work, in which position screw *N* is tightened to clamp the bushing in place. A pin at *P* locates the drill guide bushing radially, so that the four holes in the end of the work are in the proper relation to the hole in the side of the work at *K*.

In use, this jig rests on the feet *Q* and the drills held in extension shanks pass through the bushing recess *R*, and are guided through section *D* of the bushing in the usual manner.

* * *

Wanderer-Werke Celebrate Fiftieth Anniversary

One of the outstanding plants in Europe manufacturing milling machines—the Wanderer-Werke, of Schönau-Chemnitz, Germany—celebrates its fiftieth anniversary this year. The company was formed in 1885 by two mechanics, J. B. Winklhofer and R. A. Jaenicke, and was at first known as Winklhofer & Jaenicke A.G. At first the company manufactured bicycles, but in 1899, the manufacture of milling machines was begun with the object of supplying the required equipment for the company's own plant. Later, the milling machine manufacturing business became a most important part of the company's achievements, and for the last thirty years the company has been well known as a leading milling machine manufacturer of Europe. The company has also developed the largest European business in the manufacture of typewriters and adding and bookkeeping machines.

* * *

What are among the world's most powerful electric locomotives for passenger service have recently been built in the Soviet Union. They are provided with motors developing 2700 horsepower. These locomotives are capable of a speed of eighty-one miles an hour when pulling as many as twenty Russian passenger cars on a level track.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Push-Button Mechanism for Alternately Changing Position of Lever

By P. E. VERAA

The accompanying illustration shows a mechanism designed to change the position of lever *C* from *A* to *B* or vice versa each time the push-button *D* is operated. The cam-shoe *F*, Fig. 1, which is an extension of push-button *D*, is in position for changing lever *C* to position *B*, Fig. 2, by coming in contact with the inclined face of pawl *G* when the button is pushed upward. The upward motion of cam-shoe *F* will cause pawl *G* to move in the direction of arrow *O*. When the cam-shoe reaches the end of the incline, the fulcrum of the connecting links *J* will rest against the flat face of the cam-shoe. Pawl *G* will then be lifted, causing lever *C* to swing and change from position *A* to position *B*.

During this motion, the pressure of the shoe applied to the connecting links *J* automatically moves the link or pawl *H* toward the left. This obviously prevents pawl *G* from moving too far to the right and from becoming disengaged from the cam-shoe. Fig. 3 shows the push-button *D* released and returned to its normal position by spring *K*. When

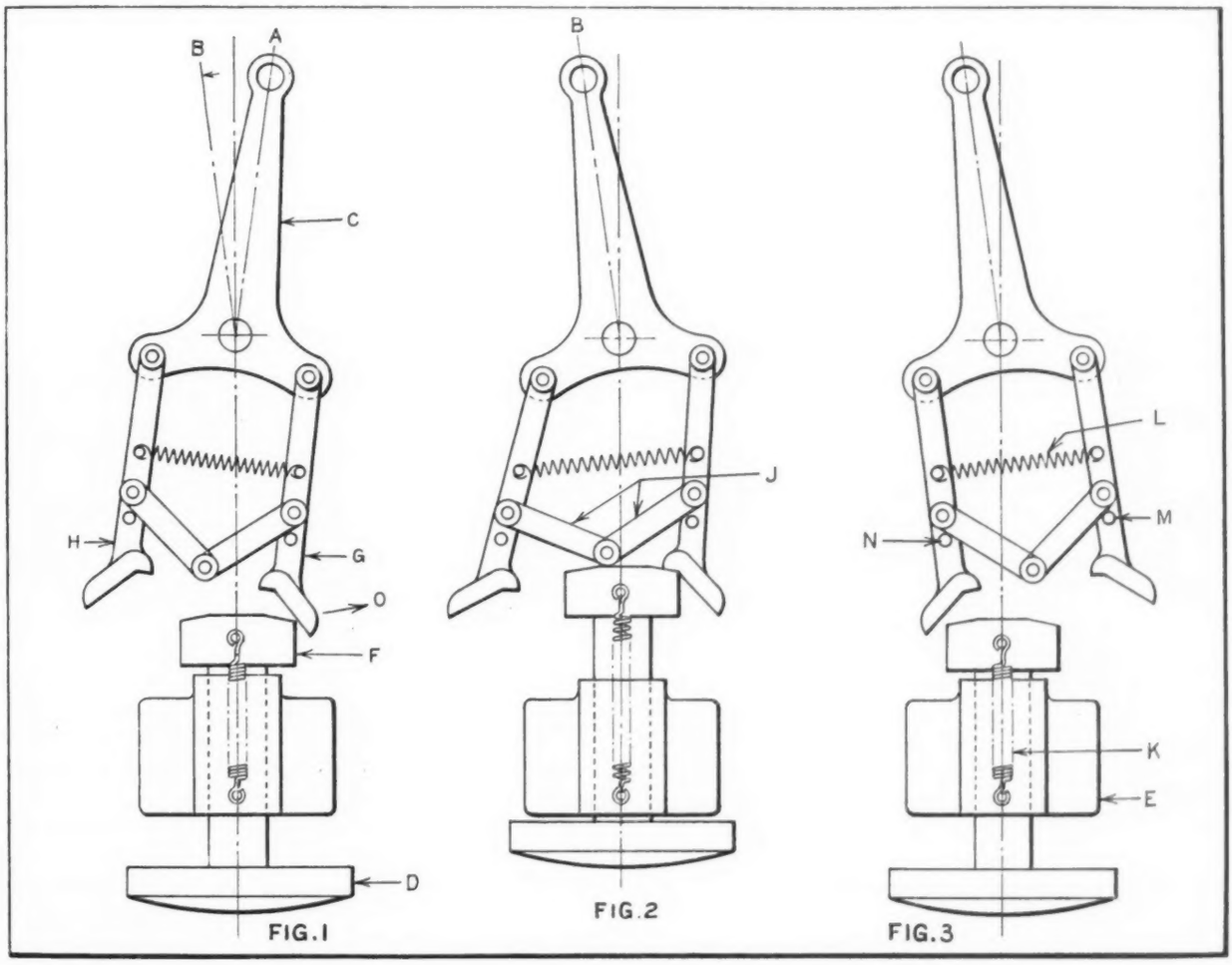


Fig. 1. Push-button Mechanism with Lever C in Position A. Fig. 2. Mechanism with Push-button Pushed in to Transfer Lever to Position B. Fig. 3. Push-button Released with Lever Remaining in Position B

the connecting links J are released from contact with the cam-shoe, the spring L causes pawls H and G to move toward each other until links J come in contact with pins M and N. Lever C is now ready to change from position B to position A when the push-button is again operated. The stem of the push-button D is square and is a sliding fit in the square hole in guide E.

Cam and Eccentric Mechanisms for Crank and Lever Movements

By PAUL GRODZINSKI

Combination link, gear, and cam mechanisms for oscillating bellcranks were described in March MACHINERY, page 411. Other mechanisms developed for similar purposes, but of somewhat different design, are shown in the accompanying illustrations. Fig. 1 shows how a crank drive actuated by an eccentric A is utilized to impart a vertical oscillating motion to the ram B. In this mechanism, gear C supports cam D and gear E supports the eccentric A. The sliding member F which carries the fulcrum of the lever G is driven by means of a connecting-rod H.

The slideway has such a position that the motion of the crank drive is parallel with that of the cam. The movements of both the cam and the crank serve to give the lever G a long stroke. A small slideway at the outer end of lever G provides the connection with the ram B.

The sliding member F may be omitted in some cases and the end of lever G connected directly to an eccentric on a crankpin, as shown in the upper view, Fig. 2. For special cases, the cam profile may also take the form of an eccentric disk. In that event, the form of the mechanism can be changed, so that the cam is replaced by an eccentric which actuates a rod. The crank-arm can also be replaced by an eccentric A, as shown in the lower view. This gives a simple mechanism having two eccentric rods coupled together by means of a link G.

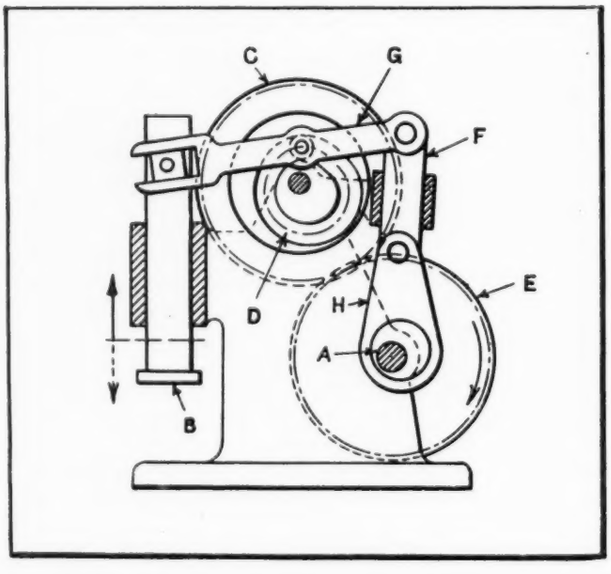


Fig. 1. Combination of Gears, Crank, Cam and Eccentric for Operating Ram

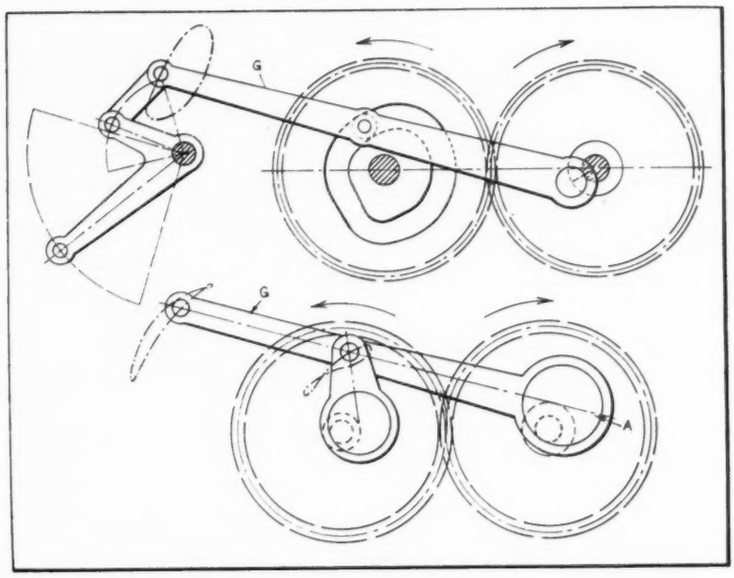


Fig. 2. Crank Mechanisms Operated by Gears and Eccentrics

Mechanism for Smoothing Wrapper Over Ends of Tapered Package

By FRANK H. MAYOH

Rods acting over rods to smooth the creases of a loosely wrapped, tapered-end package are operated in a bewildering manner by the mechanical device here illustrated. In this device, four round rods are arranged in a group at A, Fig. 1. Four rods are also arranged in a group at B. Each rod has a ball-shaped end mounted in a two-piece socket C in which the rod is free to pivot.

A group of springs D, of which eight are used in each unit, tie the rods flexibly together. In the center of Fig. 2, is indicated a tubular part X having an irregular shape with tapering ends, such as a foil-wrapped cigar. The cigar has been encased in its wrapper cylindrically and is to have the foil smoothed out and creased taperingly at the ends so that it folds smoothly over the irregularities and depressions of the rough-shaped ends.

To accomplish this, two entire mechanisms or units such as the one illustrated in Fig. 1 are employed, as shown in Fig. 2. The left-hand unit is shown at Y, and the right-hand unit at Z. The upper rods A are revolved in the direction indicated by the arrow E while the lower rods B are revolved in

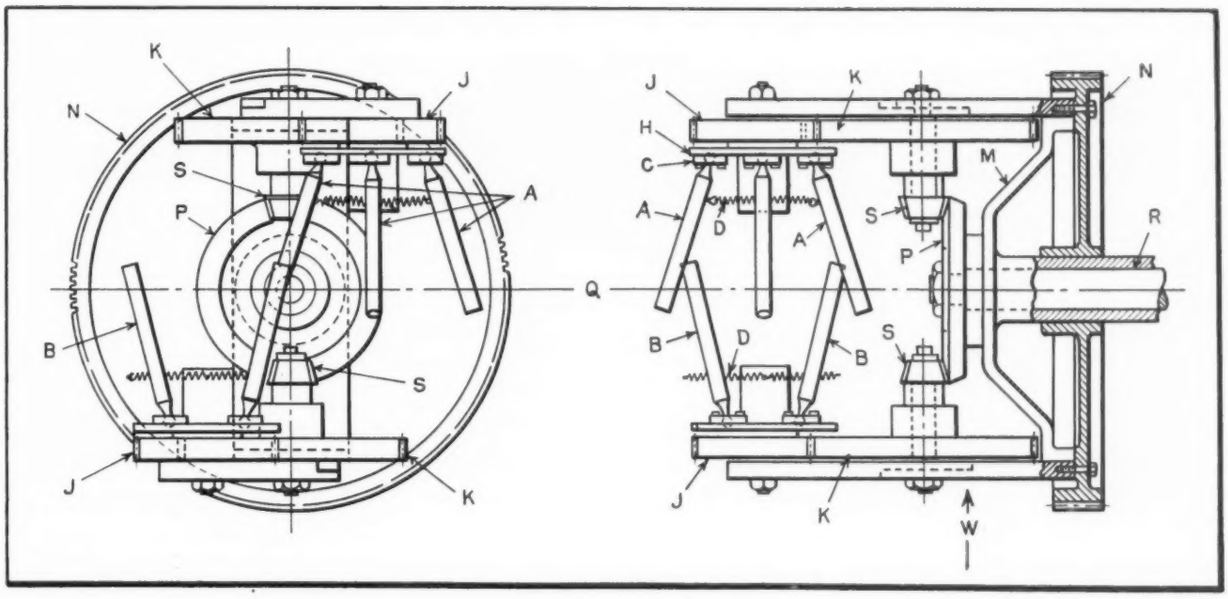


Fig. 1. Mechanism for Rotating Groups of Rods Arranged to Smooth Wrapper over Tapered Ends of Cigars

the direction indicated by the arrow *F*, the direction of rotation being determined by the bevel pinion drive. As each rod comes in contact with the wrapping on the work *X*, it smoothes and creases it. The springs yield sufficiently to allow the rods to ride smoothly over the wrapping.

Each rod head, of which four are shown in Fig. 2, has eight springs *D* attached to four retaining screws *G*, two springs being attached to opposite sides of each of the rods *A* and *B*. The rod sockets are mounted on plates *H*, Fig. 1. Plates *H* are attached to gears *J*; thus the revolving of each large gear *K* causes the smoothing rods *A* and *B* to revolve continuously and stroke the work lengthwise while the foil-wrapped part is held stationary in gripping fingers *L*, Fig. 2.

In addition, the entire rod-actuating arrangement is mounted on a bracket *M*, which, in turn, is attached to a large gear *N*. Gear *N* is caused to revolve, thereby carrying the entire arrangement about the axis *Q*. Thus the rods not only work lengthwise along the wrapping but radially as well. These combined movements serve to draw the wrapping tight. The bevel gear *P* is revolved by shaft *R* which causes bevel pinions *S* to drive gears *K* that operate the bar-holding members. The rod-actuating units are comparatively small, and form one section of an entirely automatic machine.

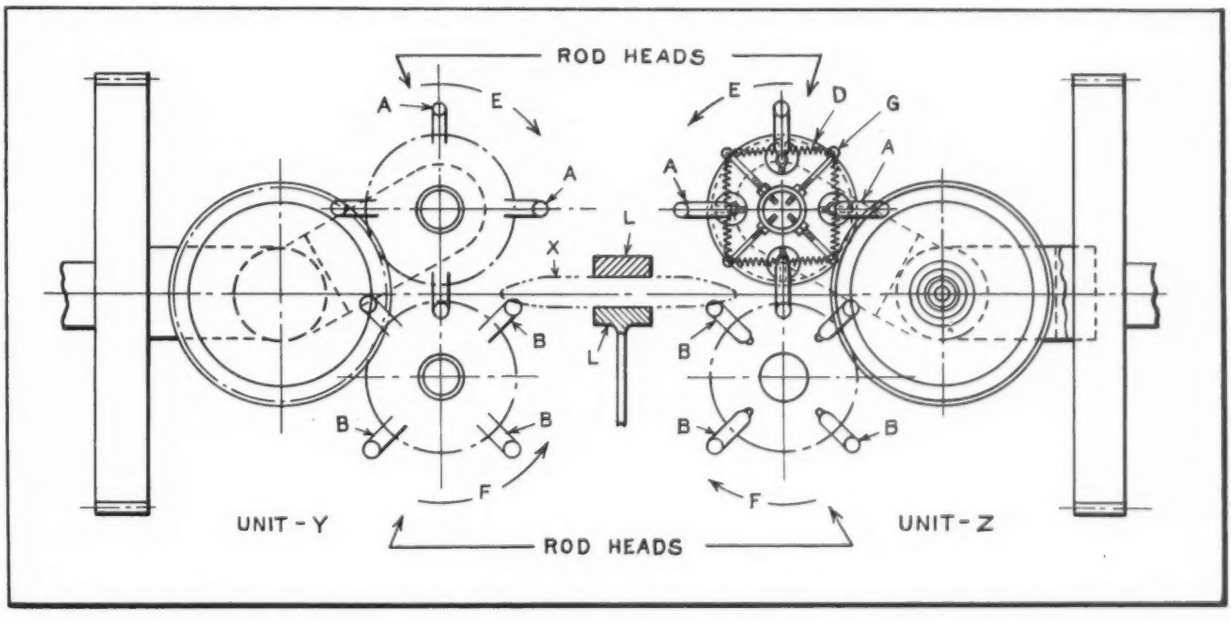


Fig. 2. Diagram Illustrating Operation of Wrapper-smoothing Mechanism Consisting of Two Units Like the One Shown in Fig. 1

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies can be Obtained by Writing Directly to the Manufacturer.

Automatic Gear-Hobbing Machines and Gear-Testers

LEES-BRADNER CO., Cleveland, Ohio. Bulletin describing the special features of the Lees-Bradner single-spindle automatic gear-hobbing machine, which is designed to produce gears of maximum accuracy economically, and is adaptable to a wide range of work, including spur gears, worm-gears, helical gears, spline shafts, and straight or taper serrations.

Bulletin illustrating and describing the new Lees-Bradner gear-testers for accurately locating and measuring the errors in gear teeth. Two machines are described, one for testing errors in tooth contour, arc of action, tooth spacing, concentricity, and length of line of action; and the other for detecting and measuring errors in the helix angle or lead of a helical gear.

Chains and Sprockets

BALDWIN-DUCKWORTH CHAIN CORPORATION, 367 Plainfield St., Springfield, Mass. Catalogue K-1, containing 54 pages (pocket size) on chains and sprockets for power transmission, conveying and elevating. The catalogue describes and lists the company's standard roller chains, parts and attachments; multiple roller chains; extended pin chains; non-corrosive chains; block chains; cable or leaf chains; special-purpose chains; steel replacement chains and sprockets for roller chains. A special feature of the catalogue is a 20-page section containing engineering data of value to chain users.

Welding Timers

ELECTRIC CONTROLLER & MFG. CO., Cleveland, Ohio. Booklet 142 entitled "Uniform Welds," which gives information on the subject of resistance welding, with particular emphasis on the use of the EC & M weld timer in spot, projection, and butt welding. A chart showing the characteristics of spot welding of some two hundred and fifty combinations of metals and wiring diagrams for welders equipped with weld timers are included. Some interesting examples of work that has been successfully welded on a production basis by the use of the weld timer are shown.

Phosphor-Bronze and Nickel Silver Alloys

SEYMOUR MFG. CO., Seymour, Conn. Leaflet on Seymour phosphor bronze, describing the outstanding characteristics of this alloy, and the applications for which it is particularly suited, which include springs, especially those subjected to corrosion; electrical connections; bushings and bearings on machinery; and engine and pump parts.

Leaflet outlining some of the many uses of Seymour nickel silver, which is suitable as a base for plating; a trimming for automobiles; drawn tubing; screw machine parts; springs, etc.

Motorized Speed Reducers

LINK-BELT CO., 910 S. Michigan Ave., Chicago, Ill. Catalogue 1515, containing complete data on the Link-Belt newly developed line of motorized speed reducers. A valuable feature of the book is the information given on the selection of motorized reducers for various classes of service. In connection with this data, four pages of selection tables are given, containing dimensions, capacities, ratings, and speed ratios for the different sizes. A specific example is included to make the use of the tables clear. New list prices have also been issued for these motorized speed reducers.

Roller Bearing Lock-Nuts and Washers

TIMKEN ROLLER BEARING CO., Canton, Ohio. Charts developed to simplify the problem of selecting lock-nuts and washers for use with Timken bearings. Full details are given for two designs, and the nuts and washers listed can be used with equal success for three other types of applications by making proper allowances. Thirty-one sizes of lock-nuts are listed for use with 457 different Timken cones in the case of Design No. 1, and 207 different cones in the case of Design No. 2.

Short-Center Belt Drives

E. F. HOUGHTON & CO., 240 W. Somerset St., Philadelphia, Pa. Booklet entitled "Vim Short-Center Drives with Vim Tred Leather Belting," outlining the characteristic features and requirements of short-center drives, as well as the advantages of the "Vim Efficiency" drive and "Vim Tred" non-slipping belts. A complete handbook on short-center drives, containing specifications for over five thousand drives at every speed and pulley ratio up to 1 to 6, is also available to engineers writing on their own letterhead.

Positive Drives

MORSE CHAIN CO., Division of Borg-Warner Corporation, Ithaca, N. Y. Booklet entitled "Positive Power Transmission," showing typical examples of Morse silent and roller chain drives, Morse couplings, Kelpo free-wheeling clutches, Pullmore clutches, Morse marine transmissions, and Morse chain automotive front-end drives. The book is profusely illustrated with large-scale views showing installations of these drives in a wide variety of industries.

Isolation of Machine Vibration

KORFUND CO., INC., 48-15 Thirty-second Place, Long Island City, N. Y. Bulletin 51C, entitled "The Need of Isolating Machine Vibration," illustrating and describing the use of

cork plates for this purpose. Bulletin 53B, entitled "Machinery Vibration Isolation by Spring Suspension," illustrating and describing Vibro-Dampers for overcoming vibration difficulties.

Hydraulic Grinders

LANDIS TOOL CO., Waynesboro, Pa. Catalogue E-35, illustrating and describing Landis 15-inch Type C hydraulic internal grinders, which are made in two sizes—a 15- by 8-inch size for the rapid output of precision work, as well as for accurate work where high production may not be a factor; and a 15- by 11-inch size for grinding deep bores.

Industrial Vacuum Cleaning Equipment

UNITED STATES HOFFMAN MACHINERY CORPORATION, Air Appliance Division, 105 Fourth Ave., New York City. Booklet entitled "Remove the Menace of Dust," dealing with the general subject of dust hazards in industry and with the use of vacuum cleaning equipment in shops and factories.

Centrifugal Pumps

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. Bulletins W-311-B1B and W-318-B4, illustrating and describing, respectively, Worthington single-stage volute and three-stage volute centrifugal pumps. Bulletins W-321-B3 and W-321-B4, descriptive of Worthington Monobloc centrifugal pumps.

Boring and Milling Machines

CROSS GEAR & MACHINE CO., 3250 Bellevue Ave., Detroit, Mich. Catalogue describing Cross Hydro-basic machines which are adapted for a wide variety of operations, such as diamond boring, tungsten-carbide boring, facing, turning, profile milling, plain milling, and multi-spindle drilling.

Ball and Roller Bearing Closures

BEARING APPLIANCE CO., Ardmore, Pa. Data sheets giving detailed dimensions of cast-iron closures for ball and roller bearings. The booklet lists fourteen different sizes of closures or covers suitable for 150 sizes of ball and roller bearings.

Tractor Cranes

SILENT HOIST, WINCH & CRANE CO., 762 Henry St., Brooklyn, N. Y. Bulletin 45, on the Krane Kar and Krane Krawler, showing applications of these gasoline tractor cranes and giving blueprints and capacity diagrams, together with complete descriptions and specifications.

Conveying and Transmitting Equipment

CHARLES BOND CO., 617 Arch St., Philadelphia, Pa. Circular listing Bond stock gears and sprockets, flexible couplings, and truck casters. Booklet GA-33, containing tables of dimensions, capacities, and prices of Bond stock speed reducers.

Pressure Blast Nozzles

NORTON CO., Worcester, Mass. Circular containing data (including prices) on Norbide pressure blast nozzles provided with liners of Norton Boron Carbide, which greatly increases the length of life. Instructions for selecting and using these nozzles are included.

Magnetic Pulleys

MAGNETIC MFG. CO., Milwaukee, Wis. Bulletin 300, descriptive of a portion of the standard line of magnetic pulleys and magnetic pulley type separators made by this company. Complete specifications are given on sizes from 12 inches in diameter up.

Air Pumps

LEIMAN BROS., INC., 154 Christie St., Newark, N. J. Catalogue A-135, illustrating and describing this company's line of rotary positive air pumps for operating gas furnaces, textile machinery, oil burners, and many other devices and special machines.

Paint

SHERWIN-WILLIAMS CO., 101 Prospect Ave., N. W., Cleveland, Ohio. Catalogue entitled "Plant Conditioning—A Guide to Profit through Paint," showing how costs can be reduced in many places in industrial plants through the proper use of paint.

Motors

LOUIS ALLIS CO., Milwaukee, Wis., is publishing every other month a 24-page magazine known as "The Louis Allis Messenger." The publication contains engineering data and technical articles on electric motors, as well as material relating to the activities of the concern.

Leather Packing

MICHIGAN LEATHER PACKING CO., 752 Fourteenth Ave., Detroit, Mich. Bulletin 701 on mechanical leather packings and oil seals. The bulletin includes illustrations and a description of an unusual and exacting test made on one of the various types and designs of mechanical leather packings manufactured by this concern.

Drill Steel

BETHLEHEM STEEL CO., INC., Bethlehem, Pa. Catalogue containing information on the methods of manufacturing and processing Bethlehem hollow drill steel. Information is also given on types of bits, function and characteristics, size, weight, etc.

Stainless Steel

ALLEGHENY STEEL CO., Brackenridge, Pa. Bulletin A-1, containing information on the chemical composition, properties, and applications of Allegheny metal, a corrosion-resistant steel. A revised price list for Allegheny stainless steels has also been issued.

Pneumatic Tools

CHICAGO PNEUMATIC TOOL CO., 6 E. 44th St., New York City. Catalogue SP-1876 covering the line of "Power Vane" rotary tools made by this concern, which includes pneumatic drills, grinders, wrenches, wood borers, and concrete surfacers.

Cold-Drawn Steel

UNION DRAWN STEEL CO., 232 Harsh St., Massillon, Ohio. Circular entitled "Name the Steel Properties you Require," descriptive of the facilities of this company for cold-treating and heat-treating steel bars to meet all requirements.

Magnetic Jig Blocks

BARKER TOOL, DIE & GAUGE CO., 5529 Ellery St., Detroit, Mich. Folder illustrating and describing the application of Jones magnetic jig blocks with cast-in-place pole extensions and pole separators to facilitate the holding of work.

Gear-Tooth Rounding and Chamfering Machines

CROSS GEAR & MACHINE CO., 3250 Bellevue Ave., Detroit, Mich. Circulars and leaflets describing the complete line of Cross gear-tooth rounding, pointing, chamfering, and burring machines.

Pyrometers

C. G. TAGLIABUE MFG. CO., Park and Nostrand Aves., Brooklyn, N. Y. Circular illustrating and describing the Tag indicating potentiometer controller provided with a photoelectric cell and a mirror galvanometer.

Gears and Sprockets

MEDART CO., 3500 De Kalb St., St. Louis, Mo. Catalogue 56G, covering the Medart line of gears and sprockets. Dimensions, weights, and prices of molded and cut gears, as well as of sprockets and chain, are given.

Diesel Engines

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. Bulletin S-500-B6D, describing the field of application and the constructional features of Worthington vertical four-cycle Diesel engines.

Plates, Sheets, and Flanging

LUKENS STEEL CO., Coatesville, Pa. Bulletin entitled "World's Largest Plate Mill and Its Products," showing typical examples of the wide range of steel plates and pressed products made by this concern.

Apprentice Training

CLEVELAND TRADE SCHOOL, Cleveland, Ohio, is publishing a paper known as the "Trade Apprentice," giving information on apprentice training and news of the activities of the Cleveland Trade School.

Belting

B. F. GOODRICH CO., 450 S. Main St., Akron, Ohio. Circular pointing out the fourteen improvements incorporated in Goodrich Highflex belting, a square-edged duck belt impregnated with rubber.

Electric Furnaces

HEVI DUTY ELECTRIC CO., Milwaukee, Wis. Bulletin HDT-235, illustrating and describing Hevi Duty high-temperature electric box furnaces using metallic resistor elements.

Leather Packings

ALEXANDER BROS., INC., 406 N. Third St., Philadelphia, Pa. Bulletin A49, containing information on Alexander leather packings of all kinds for a wide variety of applications.

Traveling Cranes

WHITING CORPORATION, Harvey, Ill. Bulletin 195, describing the features of construction and the advantages of LH and LHE hand power and electric traveling cranes.

Electric Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletin GEA-1662A, descriptive of the trip-free air circuit breakers for buildings, industrial plants, and power stations.

Paint

UNITED STATES GUTTA PERCHA PAINT CO., Providence, R. I. Circular dealing with the use of a white paint, known as "Barreled Sunlight," in industrial plants.

Multi-V Drives

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. Leaflet entitled "Grip Saves Power," listing the advantages of Worthington multi-V drives.

Gears

D. O. JAMES MFG. CO., 1120 W. Monroe St., Chicago, Ill. Circular containing illustrations showing the wide range of gears manufactured by this company.

Hand-Operated Chucks

SKINNER CHUCK CO., New Britain, Conn. Bulletin 48, containing complete data, including prices, of the Skinner line of hand-operated chucks.

Beryllium Copper

AMERICAN BRASS CO., Waterbury, Conn. Catalogue B-21, descriptive of the composition, properties, and applications of Anaconda beryllium copper.

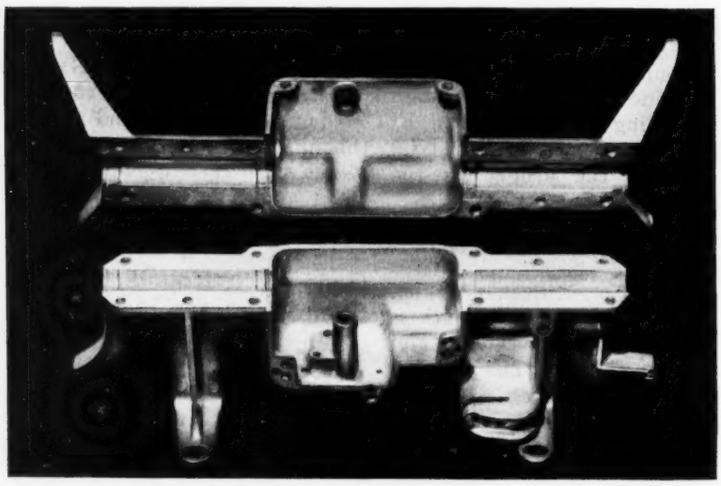
Zinc Die-Castings

NEW JERSEY ZINC CO., 160 Front St., New York City. Leaflet pertaining to the use of zinc alloy die-castings in automotive production.

* * *

Electric Eye Turns on and off Lights in Shop

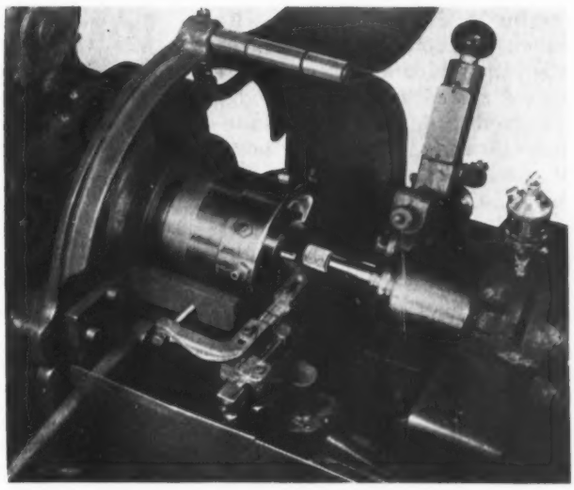
A new photronic eye control, which turns lights on and off automatically, maintaining a predetermined level of illumination, has been placed on the market by the Weston Electrical Instrument Co., Newark, N. J. The desired turn-on and turn-off illumination values are simply set in advance on two independent scales, and at these values the photronic cell actuates a relay controlling the light circuit through a mercury switch. The circuit is so designed that momentary shadows do not affect the automatic control.



Die-castings have been Widely Adopted in the Automotive and Allied Fields Because of their Dependability, Economy, and the Latitude of Design that They Afford. Two Aluminum Die-castings Made by the Superior Die Casting Co., Cleveland, Ohio, for Gasoline Dispensing Pumps are Shown Here. They Illustrate the Intricacy of Designs that can be Successfully Die-cast. These Castings are 12 Inches Long and Weigh One Pound Each.

Shop Equipment News

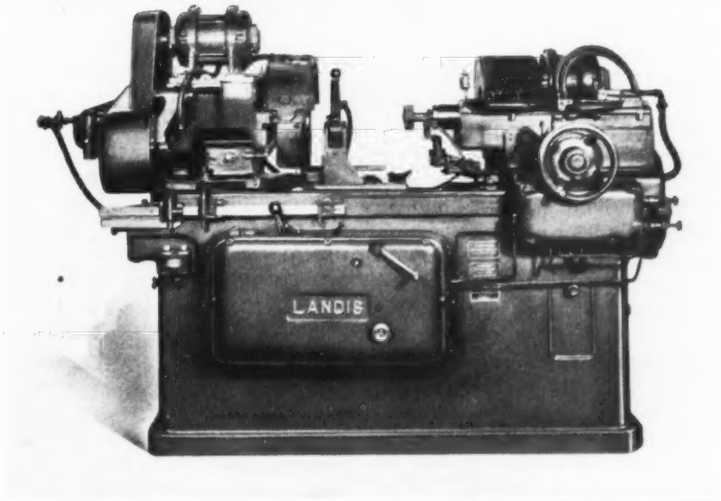
Machine Tools, Unit Mechanisms, Machine Parts and Material-Handling Appliances Recently Placed on the Market



Landis Hydraulic Internal Grinders

Hydraulically actuated internal grinding machines designed primarily for the rapid production of similar parts to a close degree of accuracy are being introduced on the market by the Landis Tool Co., Waynesboro, Pa. Although these Type C internal grinders are especially intended for production operations, they are flexible enough to serve with equal efficiency in the small-lot grinding of a wide variety of work.

Two machine sizes are available. There is a 15- by 8-inch machine which is intended for grinding the smaller bores. The particular features of this machine are a Landis-Solex sizing device and a hydraulically reciprocated grinding-wheel fixture. These features can be omitted when the machine is not intended for production grinding. The other size machine—15 by 11 inches—is intended for the deeper bores. The latter machine is equipped with a sizing device and hydraulically reciprocated grinding-wheel fixture only on special order.



Landis Internal Grinding Machine Designed for High Production

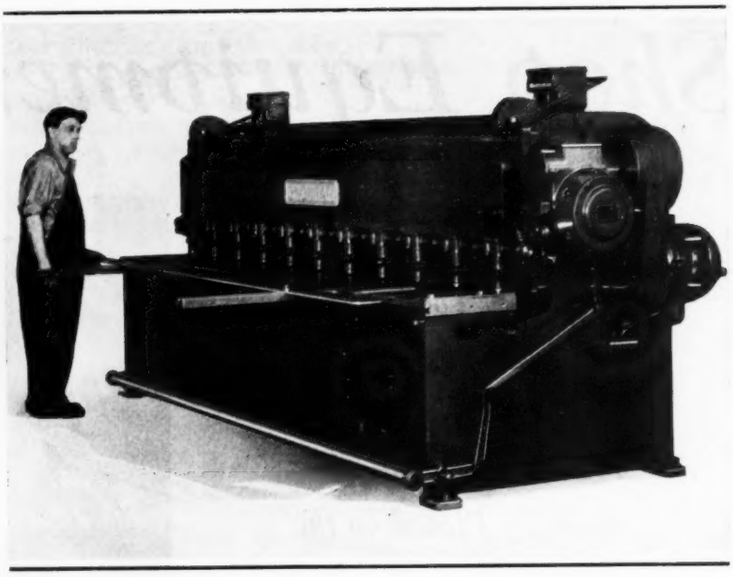
The Landis-Solex sizing device functions during the entire grinding cycle, and as it registers directly against the work, such variables as wheel wear, difference in the amount of stock to be removed, and spring in the grinding-wheel quill do not affect its accuracy. The sizing device can be used in grinding any straight or tapered hole, whether blind or not, as well as in grinding splined, keywayed, or otherwise interrupted holes. The operation of the device is based on a change in air pressure which causes machine movements to be effected through mercury type and solenoid switches.

The grinding-wheel fixture is hydraulically reciprocated in

grinding bores 2 3/4 inches in depth or less (most bores ground on a high-production basis fall within this range). With this arrangement, a relatively lightweight mechanism is reciprocated, and so traversing and reversing are accomplished with unusual smoothness. The wheel-base and grinding-wheel fixture are supported by a heavy bridge type bed which further eliminates vibration. In grinding bores of greater depth than 2 3/4 inches, the work-table is reciprocated, also hydraulically. Tapered bores with included angles up to 90 degrees can be ground on the standard machine.

Another important feature of the machine is a device that automatically compensates for any spring in the grinding-wheel quill, thereby producing unusual wheel economies. All valves, piping, and connections are easily accessible for inspection. Many of the machine movements take place automatically during the grinding cycle, and manual operations are normally performed during the automatic machine movements.

Other construction features include an Ex-Cell-O ball-bearing spindle, which is well supported close to the wheel and driven in such a manner that ample power is delivered to the spindle, regardless of the load. The grinding-wheel feed can be operated automatically or manually, in either case through a large feed-screw and nut. Backlash of the wheel-base is eliminated by a hydraulic device. The bed of the machine is of box type construction and has integral water and oil reservoirs.



Cincinnati All-Steel Shear Built in 8-, 10-, and 12-foot Lengths

Cincinnati Smaller-Series All-Steel Shears

Shears having a capacity for cutting up to No. 10 gage mild steel in lengths up to 8, 10, and 12 feet, have been added to the All-Steel line of the Cincinnati Shaper Co., Hopple, Garrard, and Elam Sts., Cincinnati, Ohio. From the 10-foot shear illustrated, it will be seen that the general design of these machines is the same as that of the heavy shears manufactured by the same company. The main frame, table, and cross-head are cut from heavy rolled steel plate. Hydraulic hold-downs with plungers spaced at 12-inch centers develop a pressure of approximately 2000 pounds each. The shear is driven by a five-jaw clutch which is totally enclosed and runs in oil. In addition, a friction slip or clutch is provided in the flywheel rim as an overload protection.

Characteristic features of this shear are an operating speed of 60 strokes a minute and the use of four-edge solid knives which have a rake of only 5/16 inch per foot. The standard equipment includes a knife-guard, automatic lubricating system, side gage, front gage with extension arms, and a ball-bearing universal back gage. The latter is adjustable through a dial reading to sixty-fourths of an inch.

This shear is regularly furnished with a 6-inch throat in the housing. A slitting gage can be provided, by means of which long sheets can be cut in two or more operations as accurately as with a single cut and without any indication of where the successive cuts were started on the material.

A three-button control is provided for the motor, there being an "inching" button for operating the shear in setting the knives. Electric lights are placed on the machine and they can be so focussed as to facilitate the shearing of sheets to scribed lines.

Dumore Compressor-Motor

The Dumore Co., Racine, Wis., has brought out a combination motor and compressor which was designed primarily for spraying paint, but which can also be used for spraying insecticides and lacquers. The air-cooled motor of this equipment has a rating of 1/10 horsepower. It is of the universal type, operating on either alternating or direct current. The compressor part of the unit develops a dead-end pressure of 20 pounds per square inch. The unit weighs only 3 3/4 pounds, and can therefore be easily applied to small devices requiring a light portable compressor.

Henry & Wright Double-Crank Welded-Steel Presses

The latest addition to the line of welded-steel presses built by the Henry & Wright Mfg. Co., Hartford, Conn., consists of single-geared straight-sided double-crank presses arranged with automatic double-roll feeds and scrap cutters. The press illustrated has a bolster area of 36 by 47 inches, and the distance between the uprights is 48 inches. The press has a 6-inch stroke and operates at 60 strokes a minute. The roll feeds of this machine will handle material up to 12 1/2 inches in width, and feed-in increments up to 14 inches. The approximate weight of the press, exclusive of the motor, is 29,000 pounds.

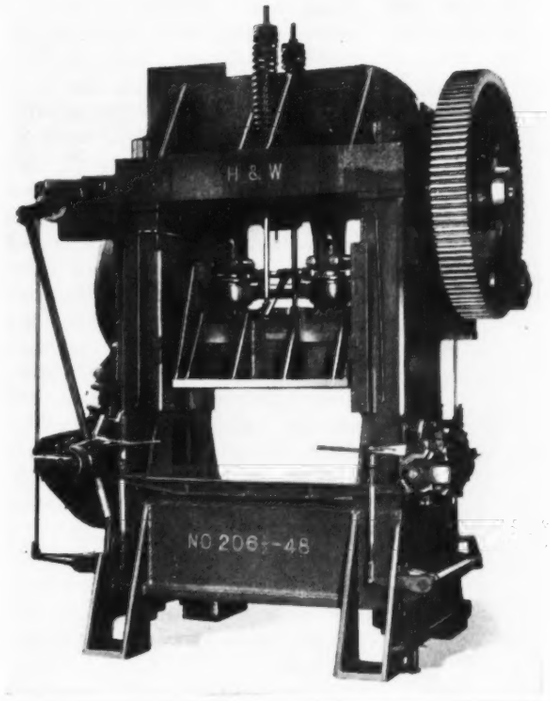
The presses of this new line are of the shrunk-in, tie-rod construction. The bed, uprights, crown, and slide are of welded steel, and are heat-treated after welding but before machining. The large gears are also of welded steel. Their construction permits the use of steel of a high carbon content for the rim, so that the teeth are very tough and of good wearing qualities.

The drive-shafts are equipped with Timken bearings contained in cartridge type mountings. This construction permits the entire drive-shaft assembly to be removed without disturbing the original bearing adjustment. It also facilitates the erection of a machine at the plant of the customer when the machine must be shipped disassembled.

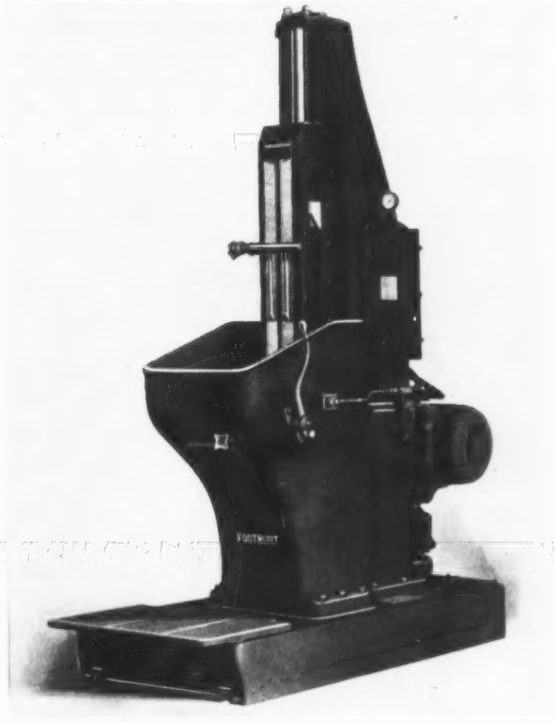
The automatic double-roll feeds are the same as those used on the dieing machine built by this concern, but are modified slightly to obtain proper mounting on the sides of the welded-steel frame. Hardened rolls ground to close limits provide accuracy of feed at high speeds. The rolls are actuated by a rack and pawl mechanism. The scrap cutter is driven from the crankshaft by an individual slide and pitman.

Footburt Single-Slide Vertical Hydraulic Broaching Machines

A hydraulically actuated single-slide machine has been brought out by the Foote-Burt Co., Cleveland, Ohio, to supplement the line of duplex and continuous broaching machines built by that concern. The new machine is simple in design and can be quickly changed over for broaching different parts. Only the work fixture and broach-holder need be changed in most cases, and for broaching plain flat surfaces often only the fixture need be changed, because broaches can be designed to handle several parts. The cutting stroke is adjustable for length by simply



Latest Addition to the Line of Henry & Wright Welded-steel Presses



Footburt Surface Broaching Machine of Single-slide Construction

moving a stop-dog on the broach slide. The machine is built in two sizes, of five and ten tons capacity, the smaller machine being shown in the illustration.

While this machine has been designed primarily for broaching a variety of parts with minimum set-up times, high production can be obtained on small parts of limited surface area by stacking two or three pieces in the fixture and using one broach or by placing two or three pieces side by side in the fixture and using a similar number of broaches. For example, in an operation in which the down stroke consumes 8 seconds and the up or cutting stroke 4 seconds, the total time per cycle would be 12 seconds, and there would be 300 complete cycles an hour. If three pieces were broached at one time in this operation, the production would amount to 900 pieces an hour.

In operating this machine, the piece of work is placed in the fixture and the operator then moves the lever on the right-hand side of the machine to push the table into the cutting position. When the table reaches this position, a valve is automatically opened to start the broach-slide on its downward stroke. As soon as the broach has passed the work, the table is automatically returned to the loading position by the action of a cam. The broach-slide then returns to the starting position and remains there until the lever is again moved to repeat the operation.

The reciprocating movements of the broach-slide are derived from a hydraulic pump, driven by a constant-speed motor through V-belts. A hydraulic plunger is fastened directly to the lower end of the slide, the column of the machine enclosing the hydraulic cylinder, pump, valves, and all piping. The cylinder is located between the ways of the machine and the cylinder head forms the top of the column. A tank which holds a generous supply of oil for the hydraulic system is contained in the lower part of the column.

Broaches of heavy back-type construction and of unusual length are employed, so that the individual teeth will not have to take heavy cuts. The broach teeth have a double curvature, designed to reduce chip friction and to enable the chips to expand and readily fall from the teeth. Broaches are, of course, usually designed for each individual job. The broach can be easily removed from the holder for sharpening.

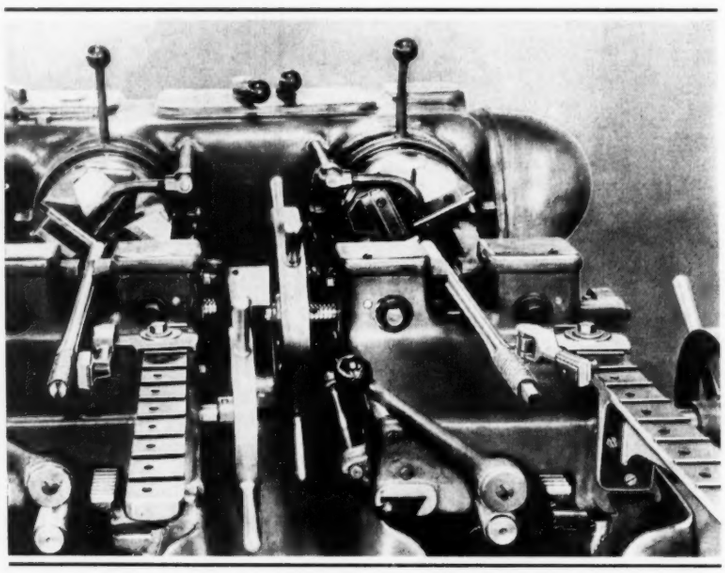
Staybolt Timing Attachment for Landmaco Threading Machines

The Landis Machine Co., Inc., Waynesboro, Pa., has recently designed an attachment for use on Landmaco threading machines in threading reduced-body staybolts with a continuous-lead thread on both ends. The timing attachment consists of a bracket attached to the carriage end cover. Positions are provided on this bracket for mounting a thread-timing gage, as may be required for various lengths of staybolts.

The gage is held on an arm, so pivoted as to permit the gage to be readily moved for engaging a thread or for disengaging. In the illustration, the gage of the attachment on the right-hand side of the machine is shown swung back to permit the removal of the staybolt, while the gage of the attachment on the left-hand side of the machine is about to be engaged with the thread of another staybolt.

The usual practice is to thread one end of the staybolt in the customary manner on one side of the machine without using the timing attachment. The set-up for threading the other end is made with a master staybolt which has been accurately threaded on both ends. The master staybolt is inserted in the die-head and the chasers are closed to engage the thread. Then the timing attachment gage is mounted to suit the length of the staybolt, and the carriage is so positioned that the gage will enter the threads on the back end of the master staybolt.

Next, the lead-screw gears are disconnected and the lead-screw is turned by hand until it engages the lead-screw nut, after



Landmaco Machine Equipped with Timing Devices that Insure Threads of Continuous Lead on Staybolts

which the lead-screw gears are again connected. After the original set-up has been made, a thread of continuous lead is insured on both ends of staybolts.

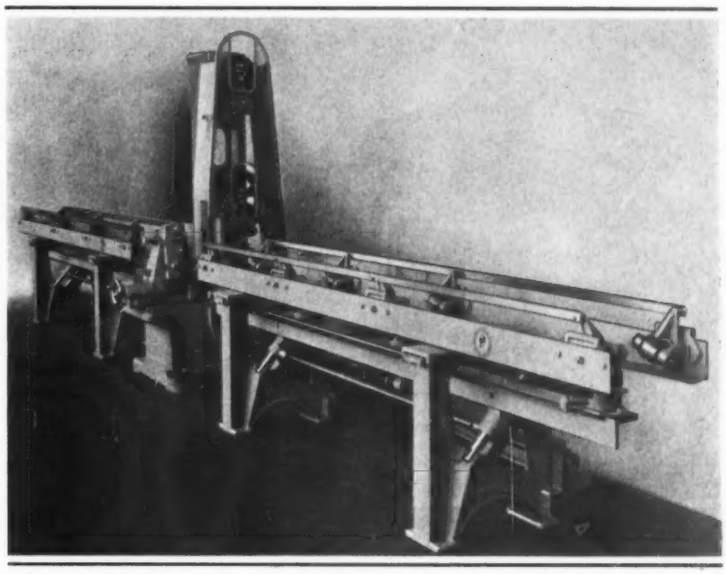
The timing attachment can be adjusted laterally if desired. Gages of different thread forms, such as U. S., vee, or Whitworth, and of different pitches, can be readily interchanged. Only one timing attachment is usually required on double-head machines.

Abrasoweld Self-Hardening Electrode

A hard surfacing electrode developed for building up straight-carbon, low-alloy, or high-manganese steel surfaces to resist abrasion is being introduced to the trade by the Lincoln Electric Co., Cleveland, Ohio. This new electrode, which is known as "Abrasoweld," is particularly suitable for restoring gear and pinion teeth; teeth, lips, and bottoms of power shovels; lugs and treads of tractors; housings and impellers of centrifugal sand pumps; parts of agricultural machinery, etc.

The new electrode provides a deposit of abrasion-resisting alloy which surface-hardens very rapidly under conditions of impact and abrasion. This type of deposit has certain advantages over a deposit that is of maximum hardness when deposited. For example, the tendency of the deposit to chip off in service is eliminated. Maximum hardness is developed only at the surface where it is cold-worked, so that a tough core is left to resist shock. Moderate peening will increase the hardness of a deposit from 20 or 30 Rockwell C to approximately 50 Rockwell C. Weld metal produced with this electrode must be ground to shape, because it cannot be filed or machined.

An additional advantage is that the deposit of this electrode is more resistant to corrosion than high-manganese steel. The deposit can be forged hot without materially altering its physical properties.



Equipment Designed for Supporting and Feeding Long Tubes in Polishing Operations

Feeding Fixture for Long Bars and Tubes

In polishing tubes or bars over 10 feet in length, it is generally necessary to provide a means of supporting them and of rotating and feeding them through the machine. To meet this requirement, the Production Machine Co., Greenfield, Mass., has developed power-driven equipment that is adjustable to suit diameters from 5/16 inch to 6 inches. Lengths up to 15 feet can be accommodated without auxiliary supports, and work weighing up to 500 pounds can be handled.

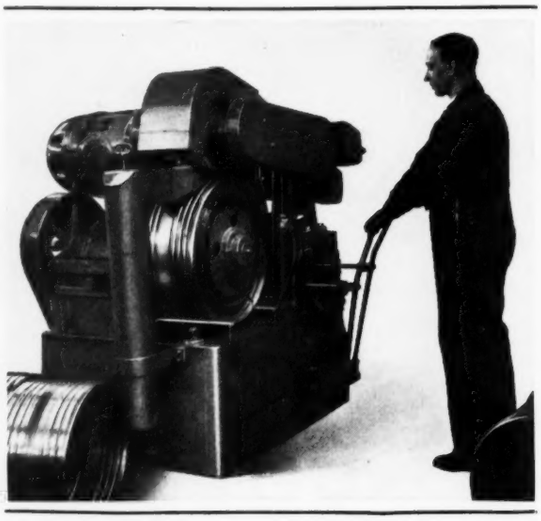
The work rests on positively driven feed-rolls which rotate it at the desired speeds and advance it through the machine at feeds that are adjustable from 0 to 20 feet a minute. Idler side rolls keep the work central with the feed-rolls. These side rolls are located on the horizontal center of the work. The front side rolls are adjusted horizontally through racks and pinions to suit different diameters of work. The feed or supporting rolls are adjusted as one unit at an angle of 45 degrees to suit different work diameters. All rolls are adjusted angularly in order to change the rate of feed.

One of these fixtures is placed on each side of the polishing machine to handle the work as it enters and leaves the wheels. Patents have been granted and are pending on features of this equipment.

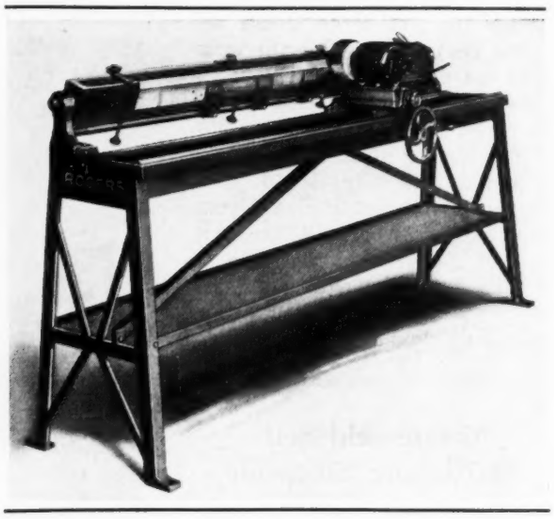
Lyon Improved Hydraulic Lift Trucks

Hydraulic lift trucks are now made in three standard capacities of 3500, 5000, and 6000 pounds, by the Lyon Iron Works, Greene, N. Y. These trucks are of the same general design as the one described in MACHINERY, April, 1931, page 642, except that the frame is constructed of angle-irons instead of channel irons and flat bars. The new construction has increased the rigidity and strength and provided a wider bearing for the skid platform.

Timken roller bearings in the front wheels take the side thrust in turning, thus making steering easier and lessening wear on the wheels. A new leak-proof air vent permits the truck to be turned over for greasing the wheels, or for other purposes, without losing oil. The trucks are painted green and aluminum.



Diamond Grinding Machine with Four Wheels for Finishing Refrigerator Drums



Machine Adapted to Grinding Small Dies and Shear Blades

Diamond Grinding Machine for Refrigerator Drums

The condenser drums used on one type of mechanical household refrigerator are made with eight circumferential welds. The Diamond Machine Co., Providence, R. I., recently built the machine here illustrated for grinding and polishing the welded surfaces of these drums, in order to improve the appearance of the completed unit and reduce finishing operations to a minimum.

This machine is equipped with four abrasive wheels, 14 inches in diameter, which are driven by a single 20-horsepower motor through V-belts. The two center wheels are mounted on a spindle equipped with anti-friction bearings and with provision for equalizing the pressure between the wheels. The end wheels are mounted on separate spindles, also equipped with anti-friction bearings. These spindles are mounted at the end of vertically swinging arms so that they can be raised or lowered in relation to the work. The arms swing about the centers of the driving pulleys and can be varied in length to permit belt adjustment.

The arms are counterweighted, so that the wheels are normally lifted away from the work. The pressure of each wheel on the work is governed by an individual hydraulic cylinder, the different cylinders receiving their pressure from a common source. This insures a uniform pressure on all wheels, regardless of their diameter, which can be varied at will.

The drum to be ground is held from the inside by a pneumatically operated expanding chuck, the holding unit being designed to accommodate drums of different sizes. This unit is driven by an electric motor through a Reeves drive, so that any desired peripheral speed can be obtained.

After a drum has been placed on the chuck, an electric push-button is pressed, which causes the wheels to move automatically into contact with the work. Four of the welds are ground at one revolution of the work-holding fixture. At the proper point, the abrasive wheels are lifted automatically a limited amount, and the work-holder stops revolving. The work is then repositioned by means of a lever to bring the remaining four welds into line with the abrasive wheels, after which the starter button is again pushed to repeat the operation. The eight welds are ground in thirty-five seconds, floor-to-floor time.

Rogers Junior Knife Grinder

Small dies and metal shear blades can be sharpened on a Junior Model knife grinder being placed on the market by Samuel C. Rogers & Co., 191-205 Dutton Ave., Buffalo, N. Y. There are three sizes of this machine, the smallest taking knives up to 61 inches long, the medium-sized, up to 76 inches long, and the largest, up to 84 inches long.

In an operation, the work is mounted on a long bar with the cutting edge up. The grinding wheel is then traversed the length of the work by turning a handwheel. Cross-feeding is accomplished by revolving a small handwheel mounted on a screw that adjusts the motor base transversely in relation to the carriage. The grinding wheel is driven by a 1/3-horsepower motor. A 6-inch cup-wheel is used.

McNeil Mill-Cut Rotary Files

The McNeil Bros. Co., Box 33, College Hill, Cincinnati, Ohio, has brought out a new line of mill-cut rotary files intended for use with flexible-shaft equipment and other small electrical tools. These rotary files are furnished in twenty-two standard

shapes, with five different types of cut. They are regularly made of an alloy file steel, although files of high-speed steel can be furnished. Special shapes can also be supplied.

Bodine Dial Type Drilling and Tapping Machine

A drilling and tapping machine of the dial type, which has a capacity for driving four 1/2-inch drills and two 1/2-inch taps in mild steel, has recently been built by the Bodine Corporation, 1720 Fairfield Ave., Bridgeport, Conn. This machine can be built for drilling or tapping only, or for drilling and tapping in combination.

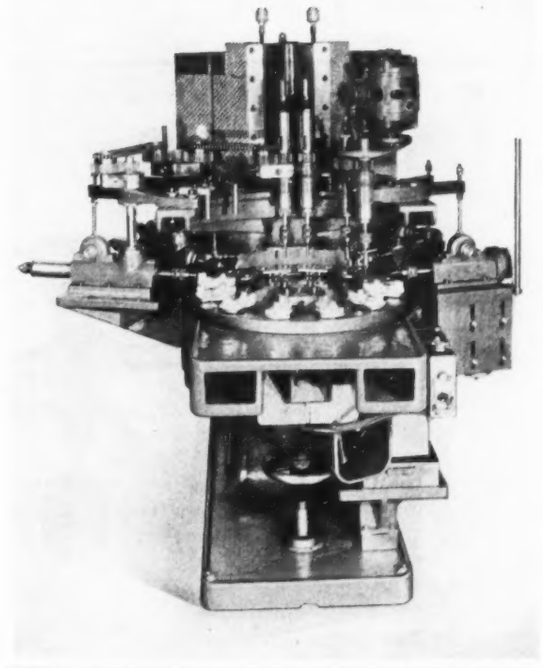
The taps are advanced and reversed by means of an oscillating segmental gear. The slide has a maximum stroke of 4 inches. The spindles are all of ball- and roller-bearing design and can be run at speeds up to 6000 revolutions per minute. Each tap spindle is equipped with a compensator that allows threads of different pitches to be tapped simultaneously. The drill spindles are provided with a vertical adjustment to regulate the depth of hole. Each spindle is adjustable as to position, and various pieces of work can be accommodated by changing dials. Either a 20- or a 30-inch knee can be furnished. The knee is provided with finished pads for attaching horizontal spindle heads or hopper feeding mechanisms.

The machine illustrated is shown with the guards removed. It has two horizontal and two vertical drilling spindles and two horizontal and two vertical tapping spindles for operations on small die-castings. The dial indexes the part as it revolves, presenting first one end and then the other to the horizontal spindles for drilling and tapping. Twenty-two pieces are produced per minute.

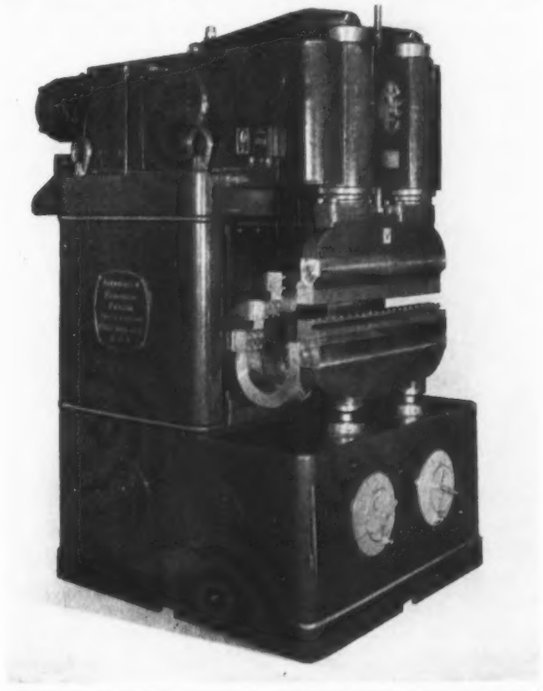
Projection Welder that Makes Twelve Hundred Welds a Minute

The American Electric Fusion Corporation, 2610-2620 Diversey Ave., Chicago, Ill., has recently built a projection welder of 600 kilovolt-amperes capacity, which is capable of making twenty-one spot welds simultaneously over a length of 36 inches. Twelve hundred complete welds can be made by the machine a minute, the speed of operation being adjustable from 30 to 60 strokes a minute. Welding pressures up to 20,000 pounds are obtainable through twin cam-actuated toggles, which are driven by a five-horsepower motor. The machine is particularly applicable for use in the manufacture of automobile bodies, refrigerator shells, and wire-mesh structures.

This welding machine was



Dial Type Machine Arranged for the High-production Drilling and Tapping of Small Die-castings



All-welded Projection Welder which has the Appearance of being Constructed of Castings

fabricated entirely from steel plate by employing the arc-welding process. Nevertheless, as will be apparent from the illustration, the frame and other parts have the rounded corners and fillets generally associated with castings, and so the machine disproves the rather general impression that a welded-steel structure must necessarily look like a combination of structural shapes and plates.

The machine weighs 14,000 pounds, and is 88 inches high. The base is 52 inches square.

Federal Cap-Screw and Bolt Trimming Machine

A high-speed machine designed for automatically trimming cap-screws, bolts, etc., and for extruding operations has been brought out by the Federal Press Co., Elkhart, Ind. The machine illustrated will handle blanks from 1/2 to 2 1/2 inches in length, in diameters of 3/8 inch and smaller, at the rate of 140 blanks a minute. Other machine sizes are included in the line.

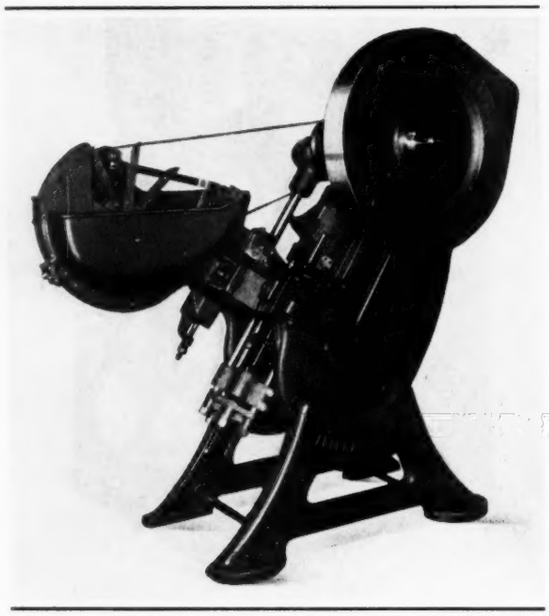
The frame, flywheel, and ram of this machine are built along the lines of standard punch presses, which constitutes a radical departure from the conventional horizontal type of trimmer. The main bearings for the crankshaft and ram are located above the point of operation, where they are free from chips and grit. The flywheel is mounted between two friction disks and is provided with a wedge take-up that eliminates any possibility of a crankshaft being sprung in case the machine should come to a sudden stop.

The hopper is of a paddle-wheel type, and it can be adjusted to suit work of various sizes. The machine is inclined 35 degrees from the vertical, and the blanks come down the raceway and are transferred to the tools at the same angle. This construction permits short transfer movements at high speed. The blank-transfer mechanism consists of two levers that are operated by direct roller contact with cams. A bar extending through the bolster plate of the machine ejects the blanks from the punch after trimming. A patented feature of the machine is an unusually simple device for shearing chips from the heads of screws.

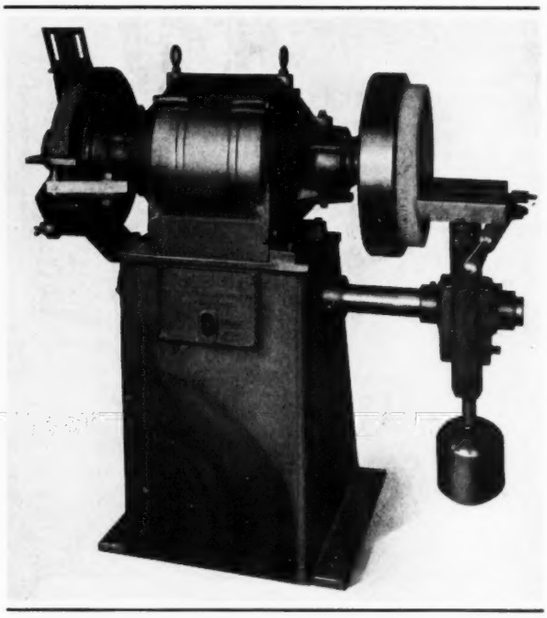
Dual-Purpose Floor-Stand Grinders

Machines designed for disk or ring-wheel grinding on the right-hand side and for regular grinding on the left-hand side have been added to the line of grinders built by the Production Equipment Co., 5219 Windsor Ave., Cleveland, Ohio. Either a plain or a universal lever-feed table can be furnished on the right-hand side of the machine. A rocker arm, balancing weight, and either a steel disk or ring-wheel chuck are standard equipment.

The left-hand side of the machine is equipped with a safety type welded steel guard having an exhaust connection and a hinged end cover. An adjustable tool-rest and either an adjustable spark shield or a safety-glass eye-shield are also regularly supplied.



Machine Designed for Trimming Cap-screws and Bolts and for Extruding Operations



Machine Designed for Disk or Ring-wheel and Regular Grinding

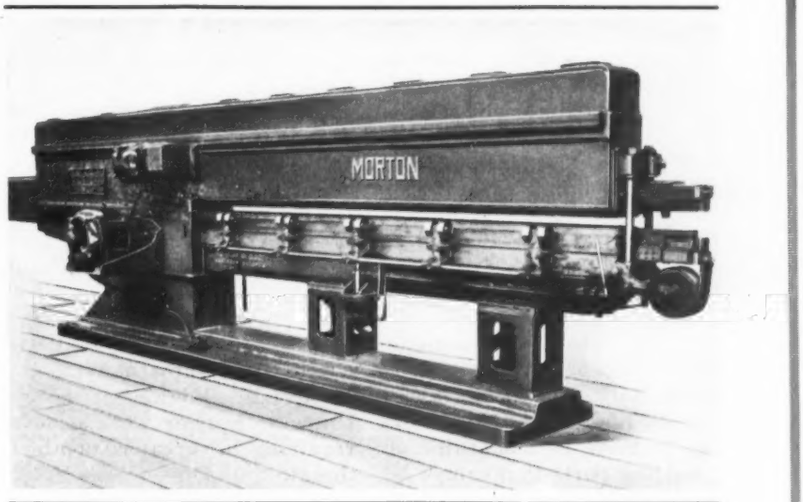
The motor is of totally enclosed, ball-bearing construction, and is arranged for oil lubrication. The starter is of the automatic type, and is located in the base with a push-button conveniently mounted. These machines are available in standard ratings from 1/2 to 10 horsepower for use with disk wheels from 7 to 20 inches in diameter.

Newton-New Haven Improved Die-Casting Machine

Larger die capacity than has heretofore been available is provided on the latest die-casting machine to be developed by the Newton-New Haven Co., New Haven, Conn. In appearance, this machine closely resembles the one brought out by the concern in July, 1934, but the new design incorporates a number of important improvements. Accessibility in die-setting has been increased by making one of the top sliding bars removable. The operator can remove this bar quickly, drop a die into place, and then replace the bar, so that the machine is as rigid as before. This construction saves a considerable amount of time with large dies, as it obviates the necessity of removing overhanging parts from a die and then reassembling the parts after the die is in place.

Roller bearings have been installed in the large cam to facilitate the operation of the machine. The camshaft has been increased in size and roller bearings are provided at both ends. A fifth bumper bar has been added to the sliding bolster to facilitate the ejection of work from overhanging dies.

Improvements have also been made in the safety device. It is fastened to the camshaft, so as to prevent the operator from making a shot unless the die is closed tight. The machine is equipped with an automatic temperature control, as previously, which insures that the metal is in the proper molten condition at all times for casting.



Morton Draw-cut Flash-trimming Machine of Unusual Length

Morton Flash-Trimming Machine with a 10-Foot Stroke

Flash can be trimmed from butt-welded sheets having seams up to 120 inches in length by a high-duty, draw-cut machine recently built by the Morton Mfg. Co., Broadway and Hoyt St., Muskegon Heights, Mich. This machine is designed to trim stock as thin as No. 20 gage. It embodies the patented Morton feature of a ram-carrying member which raises the upper ram and clamping dies 2 inches vertically for ease in loading and removing the work.

Raising and lowering of the upper ram are effected by roller-bearing eccentrics. The upper ram is provided with automatic compensation for variations in the thickness of the metal. This permits the trimming of No. 20 or No. 16 gage metal without changing the tool set-up.

Power is delivered to the two rams by a direct-connected reversing type motor. A vertical pinion driven by a built-in worm-gear reduction applies the power directly to rack teeth cut in the sides of the ram. The cutting and return speeds are approximately 60 feet a minute. A series of cutting tools is fixed in the ram by patented adjustable holders.

With the machine arranged for semi-automatic operation, the work is unclamped as soon as the rams reach their inward positions. The work can then be removed while the rams are returning to their initial positions. To insure that the clamping dies will be free from dirt, an electrical timing device operates a solenoid-controlled valve that blows a blast of air across the dies. The blast is not emitted until the rams have reached their outer positions. The duration of the blast of air is adjustable from five to ten seconds. A solenoid-operated centering and lighting device in the upper ram centers the sheet accurately with the clamping dies.

Hisey Grinders of 1/4 Horsepower Capacity

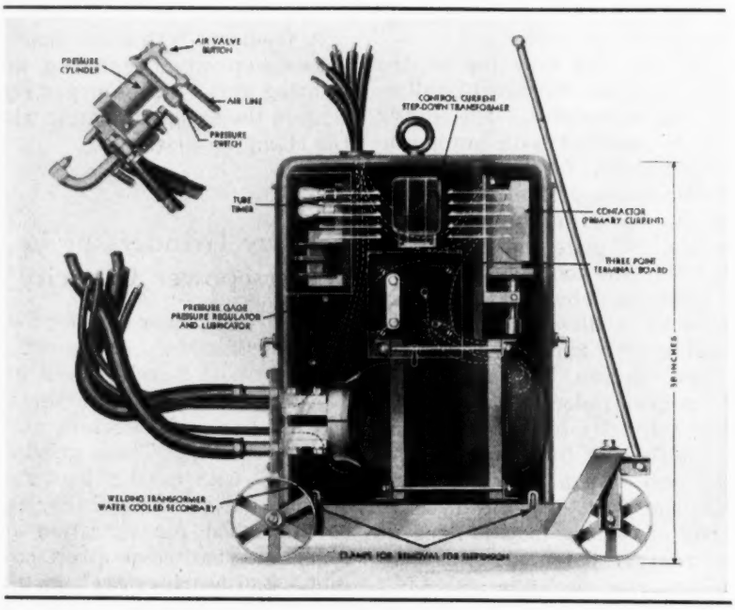
Bench and floor grinders of 1/4 horsepower capacity, equipped with 6-inch wheels, are being placed on the market by the Hisey-Wolf Machine Co., Cincinnati, Ohio. These grinders have a no-load speed of 3500 revolutions per minute and they can be furnished for operation on either alternating or direct current. Ball bearings are supplied for the wheel-spindle. They are sealed to exclude dust and grit.

Thomson-Gibb Portable Gun Type Welder

A mobile welding machine consisting of a high-speed spot-welding gun and a compact steel cabinet that contains all the transforming, regulating, contacting, and timing apparatus is the latest development of the Thomson-Gibb Electric Welding Co., Lynn, Mass. The gun is operated by a simple push-button switch. This equipment can be used on the wide range of work handled by stationary spot-welders and, in addition, it can be applied to work that is too bulky to move to a machine or for welding parts that cannot be reached by stationary machines.

The equipment is particularly adapted to assembly-line operations and to work fabricated in jigs. It can be conveniently wheeled to the work or carried by a traveling crane. An oversize transformer supplies a large volume of current for short intervals, and a weld-timer breaks the circuit the instant the weld is completed. There is no need for water- or air-cooled leads, welds being made in from one-twentieth to one-third of a second, which is too fast to heat the leads or electrodes.

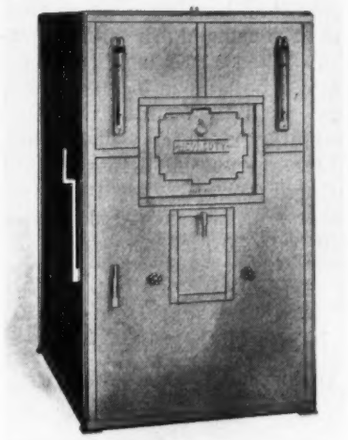
A wide variety of interchangeable water-cooled yokes can be supplied for the welding gun. These yokes are made of heavy-wall copper tubing and fitted with hard copper-alloy welding tips. A built-in limit switch on the gun automatically applies the welding current when the pressure in an air cylinder reaches a predetermined amount. The unit illustrated can weld clean metal up to No. 16 gage and the gun can be fitted with yokes having throat depths up to 12 inches. Equipment is also built for heavier work or work requiring a greater depth of throat.



Thomson-Gibb Portable Welding Equipment with High-speed Gun

Hevi Duty High-Temperature Furnaces

The development of a new metallic resistor element has enabled the Hevi Duty Electric Co., Milwaukee, Wis., to design a line of furnaces that can be operated at temperatures up to 2300 degrees F. The furnace illustrated is equipped with the Hayes "Gas Curtain" atmosphere control that provides either an oxidizing or reducing atmosphere for the charge being treated. The protective atmosphere can be introduced directly into the furnace chamber without causing the element to deteriorate.



Furnace which Operates at Temperatures up to 2300 Degrees F.

This furnace can be heated from room temperature to 2300 degrees F. in one hour and thirty-five minutes. When saturated at the temperature mentioned, the furnace has a radiation loss of 5.5 kilowatt-hours per hour. During an overnight shutdown of fifteen hours, the temperature drops to approximately 1000 degrees F., but the furnace can be reheated in the morning to 2300 degrees F. in less than an hour.

The heating element is adaptable to different types of furnaces for various requirements, such as are met with in the forging of steel, reheating of billets, annealing of stainless steel, and brazing operations.

Cleaning-Solvent Recovery Still

Users of small or moderate amounts of cleaning solvents can restore them to their original purity by means of a still recently developed by the Barnstead Still & Sterilizer Co., Forest Hills, Boston, Mass. This equipment permits cleaning solvents to be used over and over again. Some of the more common solvents that can be recovered in this way are carbon tetrachlor-

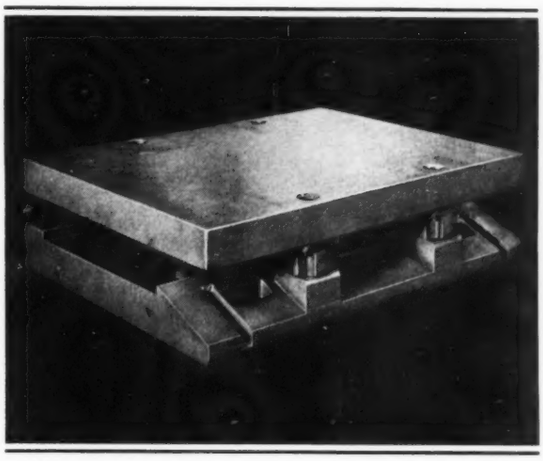


Fig. 1. Danly Die Set Welded from Steel Plate for a Blanking Operation

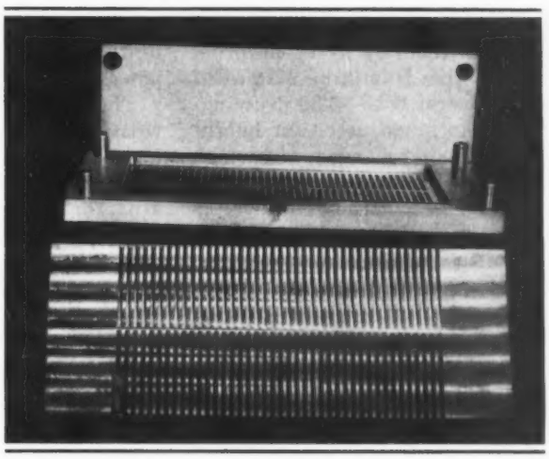


Fig. 2. Die Set in which Demountable Bosses Replace the Usual Bushings

ide, trichlorethylene, ethyl acetate, ether, alcohol, pentachlorethylene, acetone, toluol, benzol, and naphtha. Stills can be furnished for heating by steam, gas, or electricity.

Danly All-Steel Die Sets

Special die sets have been produced for some time by the Danly Machine Specialties, Inc., 2112 S. 52nd Ave., Chicago, Ill., by cutting pieces from steel plate with the torch and then welding them together. The successful service of these die sets has led the concern to develop a standard line of all-steel shoes and punch-holders. In conjunction with the tool engineers of leading automotive companies, eight types were decided upon as being most useful to the industry. A series of standard sizes were then designed to cover a wide range of dimensions.

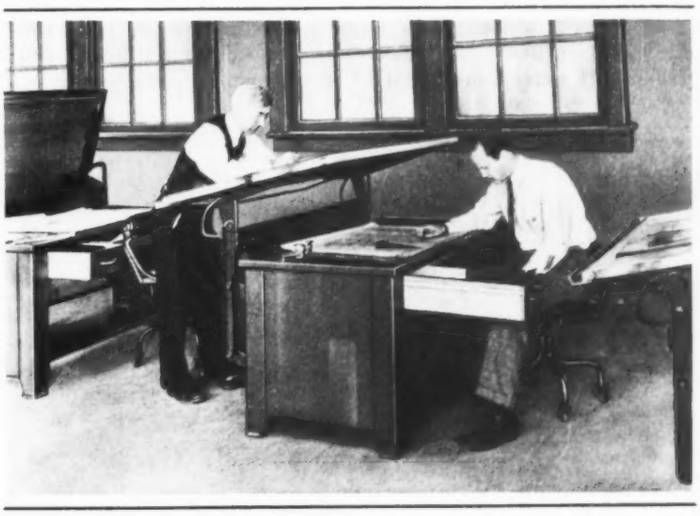
The standard line includes all-steel round die sets with back or center posts; rectangular die sets with back, diagonal, or center posts; and four-post die sets. Round sets as small as 6 inches in diameter and rectangular sets as large as 40 by 100 inches are standard.

In addition to the standard sets, any size or shape can be quickly made up by the same method. Complete plate stocks are carried in all thicknesses from 1 to 6 1/2 inches. Fig. 1 shows a steel die set for a blanking operation. The slotted slide at the bottom carries the stock out of the press.

Fig. 2 shows a demountable-boss die set in which the bosses replace the usual bushings. These bosses are regularly fastened to the shoe or punch-holder by means of four socket-head cap-screws. The bosses are readily removable, as well as the pins. This makes the complete surface of the shoe or holder, or of the die or punch mounted in them, readily available for any type of work. Demountable-boss sets are also useful when more than one die is to be mounted in the set, because of the ease of changing dies.

"Auto-Shift" Drafting Table

A full floating, counterbalanced, adjustable drawing-board top is one of the features of the combined "Auto-Shift" drawing and reference table here illus-



Combined Drawing and Reference Table with a Board that is Adjustable for Height and Angle of Incline

trated. This equipment for the drafting-room is a recent product of the Hamilton Mfg. Co., Two Rivers, Wis. The drawing-board can be adjusted for height by depressing a foot-lever, which releases a clamp that holds it in position. When the foot-lever is released, the board is again locked in place. When level, the drawing-board has a height adjustment of from 33 3/4 to 46 3/4 inches. The mechanism for tilting the drawing-board has been simplified.

The combined table and drawing-board have been designed for multiple use, it being intended that the table be used by a draftsman in front of the one who is using the drawing-board.

The same concern has also brought out a new draftsman's table with a reversible drawing-board. Another new development is a device that facilitates the removal of any tracing or drawing from a pile filed away in a drawer.

Lewellen Variable-Speed Transmission of Large Size

The Lewellen Mfg. Co., Columbus, Ind., has recently built a variable-speed transmission which is believed to be the largest completely enclosed unit of this type ever built. It has an over-all length of 84 inches, a width of 54 inches (not including the shaft extensions), and a height of 38 1/2 inches. This unit has a rating of 40 horsepower and weighs 5620 pounds.

The transmission is equipped with an electrical remote control. Ball bearings are provided throughout. All interior parts are lubricated from one end of each shaft, and they can be lubricated while the transmission is running. This transmission was built for driving two machines that manufacture roofing paper. It operates twenty-four hours a day, six days a week.

Vickers Electric-Hydraulic Control Panel

An electric-hydraulic control panel is being placed on the market by Vickers, Inc., Detroit, Mich., which permits practically every possible combination of automatic feeds and rapid traverses on hydraulically actuated machine tools and other equipment. Starting, reversing, and stopping are controlled electrically by push-buttons or limit switches, relays, and solenoids built into the control panel. A synchronous time relay which is easily varied by simply turning a dial provides a delayed reverse.

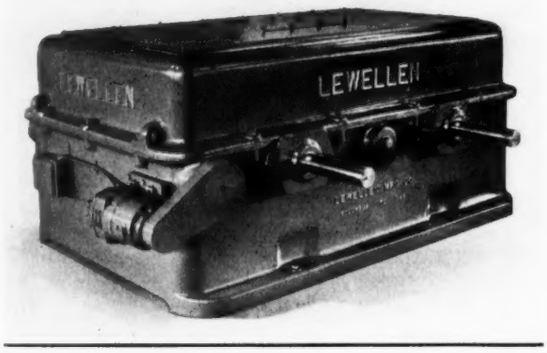
The different feed rates and rapid traverses are controlled hydraulically. They are increased or decreased by stops on the work-table of the machine depressing one or the other of the two central plungers on top of the panel. The length of any working stroke or rapid traverse can be varied by simply changing the position of the stops. The lever on the front of the panel furnishes a manual control for use in setting up the machine.

Vickers Electric-hydraulic Control Panel

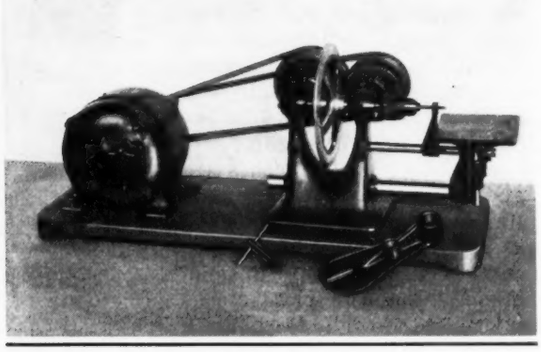
This panel is a complete hydraulic circuit except for a pump and cylinder. It requires no pump connections. The panel is available in several types and sizes.

Rickert-Shafer Self-Contained Bench Tapping Machine

A motor-driven bench tapping machine equipped complete with a motor, belts, switch, and 6 feet of cord, so that it can be placed in immediate operation by merely plugging into an ordinary light socket, has been added to



Lewellen Variable-speed Transmission of Unusually Large Dimensions



Rickert-Shafer Bench Tapper of Completely Self-contained Design